NASA SP-7043 (15)

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ENERGY

A CONTINUING BIBLIOGRAPHY

WITH INDEXES

OCTOBER 1977

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ACCESSION NUMBER RANGES

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IAA (A-10000 Series)	A77-30089 – A77-40470
STAR (N-10000 Series)	N77-22042 – N77-28059

Previous publications announced in this series/subject category include:

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NASA SP-7043(01)	May 1974	January 1, 1974 – March 31, 1974
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NASA SP-7043 (15)

ENERGY

A Continuing Bibliography

With Indexes

Issue 15

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced from July 1 through September 30, 1977 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

Scientific and Technical Information Office OCTOBER 1977
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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INTRODUCTION

This issue of *Energy: A Continuing Bibliography with Indexes* (NASA SP-7043(15)) lists 1112 reports, journal articles, and other documents announced between July 1, 1977 and September 30, 1977 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of this continuing bibliography was published in May 1974 and succeeding issues are published quarterly.

The coverage includes regional, national and international energy systems; research and development on fuels and other sources of energy; energy conversion, transport, transmission, distribution and storage, with special emphasis on use of hydrogen and of solar energy. Also included are methods of locating or using new energy resources. Of special interest is energy for heating, lighting, for powering aircraft, surface vehicles, or other machinery.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries* in that order. The citation, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR* including the original accession numbers from the respective announcement journals. This procedure, which saves time and money accounts for the slight variation in citation appearances.

Five indexes -- subject, personal author, corporate source, contract number, and report number -- are included. The indexes are of the cumulating type throughout the year, with the fourth quarterly publication containing abstracts for the fourth quarter and index references for the four quarterly publications.

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All publications abstracted in this bibliography are available to the public through the sources as indicated in the *STAR Entries* and *IAA Entries* sections. It is suggested that the bibliography user contact his own library or other local libraries prior to ordering any publication inasmuch as many of the documents have been widely distributed by the issuing agencies, especially NASA. A listing of public collections of NASA documents is included on the inside back cover.

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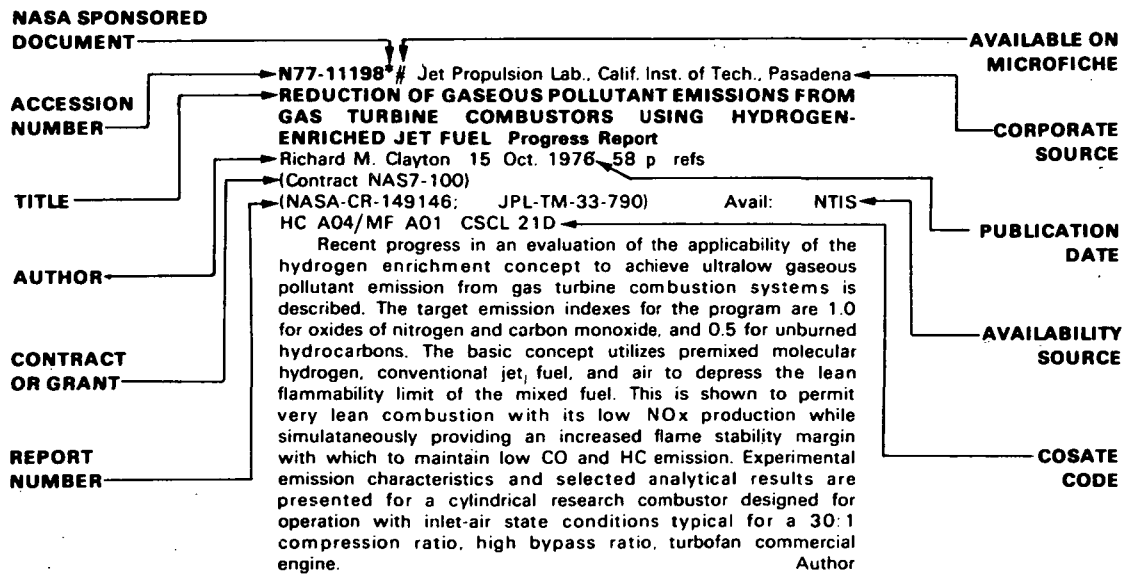
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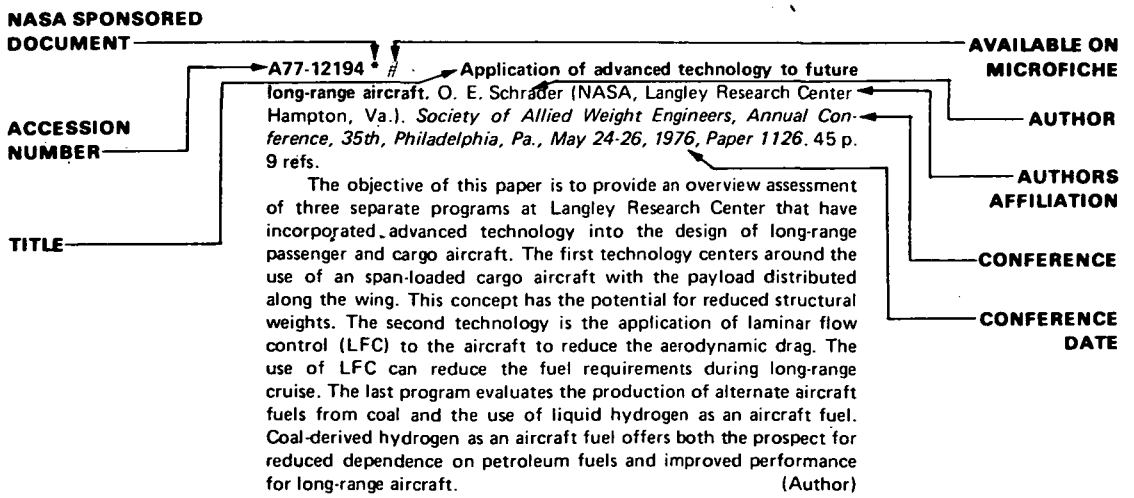
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TYPICAL CITATION AND ABSTRACT FROM *STAR*



TYPICAL CITATION AND ABSTRACT FROM *IAA*



A Listing of Energy Bibliographies Contained In This Publication:

1. World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3 1976, Proceedings. Volumes 1, 2 and 3 p 0273 A77-33326

2. Energy and the Environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29 - October 1, 1975 p 0291 A77-35146

3. Geothermal technology systems and water cycles in arid lands p 0354 N77-23592

4. Research leading to the production and early use of numeric data banks of material properties and system analyses p 0364 N77-24601

5. The analysis of subsistence associated with geothermal development. Volume 3: Information bank p 0369 N77-24716

6. Perspectives in energy: 1976 p 0372 N77-25636

7. Transportation-related data bases extracted from the national index of energy and environmental data bases. Part 1: Digest of detailed data base descriptions p 0387 N77-37036

IAA ENTRIES

A77-30100 # Combined production of electrical power and desalinated water by nuclear power plants (Produzione combinata di energia elettrica ed acqua dissalata con centrali nucleari). M. Marena, M. Nordio, and R. Senis (Ente Nazionale per l'Energia Elettrica, Centro Progettazione e Costruzioni Impianti Termici e Nucleari, Rome, Italy). *L'Energia Elettrica*, vol. 53, Dec. 1976, p. 634-649. 18 refs. In Italian.

Processes suitable for dual-purpose nuclear power plants generating electric power and fresh water supplies via desalination of sea water are described. Fresh water resources and demands are graphed for Italian regions (central-north, south, islands). Desalination processes are described and compared (multiple flash, thermocompression, multiple-effect evaporator, electrodialysis, ion exchange, back-osmosis, brine recycling, solvent extraction, freezing), and flowsheets of some dual-purpose plants are studied. Cost factors in desalting of brine streams and in the construction and operation of dual-purpose plants are discussed. R.D.V.

A77-30257 # Principles and systems for utilization of solar energy in heating and preparation of hot water (Principi i sistemi iskoristavanja sunceve energije za grijanje i pripremu tople vode). J. Pazanin and I. Vilicic (Rijeka, Sveuciliste, Rieka, Yugoslavia). *Strojarstvo*, vol. 19, no. 1, 1977, p. 45-55. 5 refs. In Croatian.

Possible direct uses of solar energy, engineering features of direct solar energy conversion systems, and storage problems are discussed. The use of direct and/or diffuse sunlight for hot water supplies, space heating, and cooling/air conditioning, data on sunlight at various geographic locations and latitudes, and features of some solar energy systems (flat-plate and concentric collectors, collector loop and secondary loop in combined systems, auxiliary process equipment) are dealt with. Collector efficiencies under a variety of weather conditions are compared, and long-term and short-term storage of solar energy in water, stone, and other media is discussed. R.D.V.

A77-30309 Design application of the Hottel-Whillier-Bliss equation. C. C. Smith and T. A. Weiss (Colorado State University, Fort Collins, Colo.). *(International Solar Energy Society, International Solar Energy Congress and Exposition, Los Angeles, Calif., July 28-Aug. 1, 1975.) Solar Energy*, vol. 19, no. 2, 1977, p. 109-113.

The reported investigation is concerned with the application of the theoretically derived Hottel-Whillier-Bliss equation as a guide to the design, the development, and the testing of flat-plate solar collectors. The equation expresses heat delivery from a collector in terms of two operational variables, including the total radiation incident on the absorber plate and the temperature difference between the entering heat-removal fluid and the air surrounding the collector. Attention is given to the significance of the design factors, aspects of prototype testing, the measurement of the design factors, and the results of the measurements procedure. G.R.

A77-30311 Calculation of long term solar collector heating system performance. S. R. Swanson and R. F. Boehm (Utah, University, Salt Lake City, Utah). *(International Solar Energy Society, International Solar Energy Congress and Exposition, Los Angeles, Calif., July 28-Aug. 1, 1975.) Solar Energy*, vol. 19, no. 2, 1977, p. 129-138. Research supported by the Utah Power and Light Co.

A calculation of system performance is necessary for an economic analysis of solar space heating systems, but is made difficult by the complexity of the system and weather parameters. The system studies in the literature have in general employed detailed computer analyses which, although informative, require detailed weather records and tend to be costly in computer time. To overcome these difficulties, a simplified technique to predict yearly system performance was developed. This simplified method is based on a computation of the system performance for a single 'average' day of each month, modifying this result with a correction factor, and summing the results over each month of the heating season. The result is that system performance can be calculated easily, by hand or with trivial computer cost. A comparison with detailed numerical analyses in the literature for systems in the cities of Phoenix, Charleston, Madison and Boston shows excellent agreement. Results are also presented for systems in Salt Lake City. (Author)

A77-30312 Solar-heated-air receivers. P. O. Jarvinen (MIT, Lexington, Mass.). *(International Solar Energy Society, International Solar Energy Congress and Exposition, Los Angeles, Calif., July 28-Aug. 1, 1975.) Solar Energy*, vol. 19, no. 2, 1977, p. 139-147. 9 refs. Research supported by the Massachusetts Institute of Technology and U.S. Air Force.

Receiver design alternatives for a central tower, heat-air receiver of a solar/gas turbine electrical generation plant are considered. Apertured and unapertured, domed-surface and -cavity receivers are examined and losses such as incident flux reflection and reradiation from the receiver are included. The receiver, constructed of ceramic domes that are individually cooled by impingement-jet heat-transfer techniques, is designed to supply heated air at 1800 F and operate in a pressurized condition at a pressure ratio of four. It is shown that high thermal conversion efficiencies (80-90%) may be achieved with cavity receivers where the interior cavity surfaces are formed from single or multiple domes. The efficiencies of surface receiver elements are found to be substantially less than those of cavities, from 54 to 70 per cent. The difference lies in the higher reradiation flux losses of surface receivers. (Author)

A77-30313 Optimum solar collector operation for maximizing cycle work output. J. R. Howell and R. B. Bannerot (Houston, University, Houston, Tex.). *(International Solar Energy Society, International Solar Energy Congress and Exposition, Los Angeles, Calif., July 28-Aug. 1, 1975.) Solar Energy*, vol. 19, no. 2, 1977, p. 149-153.

Analysis is presented to determine the optimum outlet temperature for a given solar collector that will maximize the work output for various idealized heat engine cycles. The effect of radiative and convective heat losses from the collector is demonstrated, and the relative importance of each in different operating ranges is shown. (Author)

A77-30314 Design and performance studies on a solar room heater. H. P. Garg (Central Arid Zone Research Institute, Jodhpur, India), R. Ganguli, and J. S. Puri (Central Building Research Institute, Roorkee, India). *Solar Energy*, vol. 19, no. 2, 1977, p. 155-162. 14 refs.

Almost all the research and development of solar heating has been directed towards large and expensive buildings in areas where conventional fuel and electricity are plentiful and cheap. Keeping this in mind a solar room heater capable of heating single rooms to comfortable level has been designed and tested for two winter seasons at Roorkee. Simple design curves for finding out the absorber size, for a given heating load for a number of Indian cities, and panel size for the specified requirement are developed and discussed. Water is used as a heat storage media and hot water is stored in a number of storage panels placed inside the room near the wall. Radiative and convective heat losses from the surface of panels heat the room air. Temperature distribution in the experimental and office room with and without heating it along with the ambient air temperature and solar insolation are measured and discussed. It is concluded that conventional rooms can be conveniently heated to comfortable levels by solar energy. (Author)

A77-30315 Comparison of long-term flat-plate solar collector performance calculations based on averaged meteorological data. D. L. Siebers and R. Viskanta (Purdue University, West Lafayette, Ind.). *Solar Energy*, vol. 19, no. 2, 1977, p. 163-169. 8 refs.

The use of averaged meteorological data for collector performance calculations is studied. To this end, a steady state, two-dimensional, nodal, heat transfer analysis is developed for a flat-plate solar collector. The analysis accounts for the temperature gradients in the fluid flow and vertical directions in the collector, the physical and thermodynamic properties of the materials in the collector, the collector location, the orientation and dimensions of the collector, the number of cover plates and any thin film selective coatings on the cover plates or absorber. Also accounted for are the time dependent variations in the meteorological conditions, insolation, and collimated and diffuse solar irradiation. The spectral nature of radiation heat transfer in the collector is modeled by two spectral bands, solar and thermal, with 3.0 microns as the cutoff frequency between the solar and thermal bands of radiation. The results indicate that long term collector performance calculations based on averaged meteorological data will not correlate with calculations based on hourly data if the weather is highly variable. When the weather variations are mild, averaged data can give results very close to those based on hourly data. (Author)

A77-30316 Matching of solar cells and performance of a solar battery. S. Deb, M. K. Mukherjee (Jadavpur University, Calcutta, India), and H. Saha (Jadavpur University, Calcutta; Kalyani, University, Kalyani, India). *(International Solar Energy Society, International Solar Energy Congress and Exposition, Los Angeles, Calif., July 28-Aug. 1, 1975.) Solar Energy*, vol. 19, no. 2, 1977, p. 171-177. 19 refs.

The investigation constitutes an extension of studies conducted by Deb et al. (1974) regarding the characteristics of a solar battery system and its use for irrigation in remote regions with adequate solar irradiation conditions. Attention is given to the basic problem of matching a solar cell, the constraints which might arise when the load is a dc motor, the minimization of the effect of the regular diurnal variations of insolation, and questions of power output and cost per watt of the battery. G.R.

A77-30318 Solar flux density distributions on central tower receivers. M. Riaz and T. Gurr (Minnesota, University, Minneapolis, Minn.). *Solar Energy*, vol. 19, no. 2, 1977, p. 185-194. 5 refs. Contract No. E(11-1)-2699.

An analytical approach is developed for the determination of the solar flux density distributions produced by a field of individually steered sun-following mirrors on the surface of the central receiver. The mirror field is essentially an approximation to the Fresnel equivalent of a parabolic mirror. Aspects of geometrical configuration are considered along with the dispersion factor, the mirror utilization factor, the insolation degrading factor, and the formulas for flux density calculations. The flux density distributions on vertical cylindrical receivers are investigated. G.R.

A77-30319 Dimensioning of the solar heating system in the Zero Energy House in Denmark. T. V. Esbensen and V. Korsgaard (Danmarks Tekniske Hojskole, Lyngby, Denmark). *(International Solar Energy Society, International Solar Energy Congress and Exposition, Los Angeles, Calif., July 28-Aug. 1, 1975.) Solar Energy*, vol. 19, no. 2, 1977, p. 195-199.

The paper describes the project for a Zero Energy House constructed in Denmark. The house is designed and constructed in such a way that it can be heated all winter without any 'artificial' energy supply, the main source being solar energy. With energy conservation arrangements, the total heat requirement for space heating is calculated as 2300 kWh per year. For a typical well-insulated one-storied one-family house built in Denmark, the corresponding heat requirement is 20,000 kWh. The solar heating system is dimensioned to cover the heat requirements and hot water supply for the Zero Energy House during the whole year on the basis of weather data in a 'reference year'. The solar heating system consists of a flat-plate solar collector, a water storage tank, and a heat distribution system. A total balance is set up for the system and solved for each day of the reference year. Collected and accumulated solar energy in the system is about 7300 kWh per yr; 30% of the collected energy is used for space heating, 30% for hot water supply, and 40% is heat loss from the accumulator tank. For operation of the solar heating system, the pumps and valves need a conventional electric energy supply of 230 kWh per year (corresponding to 5% of the useful solar energy). (Author)

A77-30320 Use of solar generators in Africa for broadcasting equipment. S. Polgar (TéléDiffusion de France, Montrouge, Hauts-de-Seine, France). *(International Solar Energy Society, International Solar Energy Congress and Exposition, Los Angeles, Calif., July 28-Aug. 1, 1975.) Solar Energy*, vol. 19, no. 2, 1977, p. 201-204.

A description is presented of the use of solar cells as a power supply for TV receivers in Niger. The required power for the operation of the TV receivers had, at the beginning, been provided by high-capacity alkaline electrolyte cells. Attention is given to solar irradiation characteristics in Africa, the silicon solar panels, the lead-acid storage batteries, questions of equipment maintenance, aspects of system reliability, and economic considerations. G.R.

A77-30321 * Performance data for a terrestrial solar photovoltaic/water electrolysis experiment. E. N. Costogue (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) and R. K. Yasui (TRW, Inc., Cleveland, Ohio). *(International Solar Energy Society, International Solar Energy Congress and Exposition, Los Angeles, Calif., July 28-Aug. 1, 1975.) Solar Energy*, vol. 19, no. 2, 1977, p. 205-210. Contract No. NAS7-100.

A description is presented of the equipment used in the experiment, taking into account the surplus solar panel from the Mariner 4 spacecraft which was used as a solar array source and an electrolytic hydrogen generator. Attention is also given to operational considerations and performance data, system considerations and aspects of optimization, and large-scale hydrogen production considerations. G.R.

A77-30322 Non-focussing solar concentrators of easy manufacture. M. M. Shapiro (McGill University, Montreal, Canada). *Solar Energy*, vol. 19, no. 2, 1977, p. 211-213. Research supported by the National Research Council and Atomic Energy Control Board of Canada.

A description is presented of two designs which provide more than 90 per cent of the useful heat output of a system based on a nonfocussing solar concentrator proposed by Winston (1974). Winston's device consists of a trough with 2 cylindrical mirrors of parabolic cross sections. The two new designs reported utilize mirror shapes which are easier to produce than parabolic cylinders. G.R.

A77-30372 * An isothermal etchback-regrowth method for high-efficiency Ga/1-x/Al/x/As-GaAs solar cells. J. M. Woodall and H. J. Hovel (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). *Applied Physics Letters,* vol. 30, May 1, 1977, p. 492, 493. 9 refs. Contract No. NAS1-12812.

High-efficiency p-Ga(1-x)Al(x)As, p-GaAs, n-GaAs solar cells are made by isothermally soaking n-GaAs substrates in an undersaturated Zn-doped Ga-Al-As melt. This one-step growth procedure produces a graded band gap p-Ga(1-x)Al(x)As layer 0.2-0.4 micron thick. Efficiencies of 18.5% AM0 and 21.9% AM1 have been measured. (Author)

A77-30599 Energy investment in nuclear and solar power plants. G. Moraw, M. Schneeberger, and A. Szeless (Kernkraftwerk-Planungsgesellschaft mbH, Vienna, Austria). *Nuclear Technology,* vol. 33, Apr. 1977, p. 174-183. 18 refs.

Energy analysis has been used to compare the energy investments for construction and operation of a nuclear and a solar power plant, both having the same electrical output. By means of dynamic energy analysis, construction programs for nuclear and solar power were investigated with respect to the necessary energy investment. It turns out that, considering only the energy investment aspect, present-day light water reactors use considerably less energy for their construction and operation than do solar thermal conversion plants. (Author)

A77-30600 Analysis of electrical power generation costs. R. W. Hardie and J. H. Chamberlin (GE Hanford Engineering Development Laboratory, Richland, Wash.). *Nuclear Technology,* vol. 33, Apr. 1977, p. 212-222. 12 refs.

The relative competitiveness of nuclear and coal plants is assessed by dividing the U.S. into 21 regions and using a computer model to calculate costs for each plant in each region. Scenarios were considered in which resource depletion and environmental considerations affect coal generation costs. Analysis shows that if coal prices are constant in real terms and if SO2 scrubbers are not required, nuclear plants produce electricity less expensively than coal plants in 45% of the country (adjusted for generation size). When either coal prices rise in real terms or when scrubbers are required, nuclear plants have the advantage in more than 90% of the market. In addition, sensitivity studies show that uncertainties in forecasting uranium and coal prices produce the largest difficulty in accurately comparing nuclear and coal electrical generation costs. (Author)

A77-30710 * Fundamental electronic mechanisms limiting the performance of solar cells. F. A. Lindholm (Florida, University, Gainesville, Fla.) and C.-T. Sah (Illinois, University, Urbana, Ill.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 299-304. 42 refs. Grant No. NsG-3018; Contract No. E(40-1)-5134.

Attention is focused on distortion in the energy band, and carrier recombination and generation rates (lifetimes), as the two dominant mechanisms. Spatial dependences associated with these two mechanisms, in the direction normal to the surface illuminated by the sun and in the direction tangential to that surface, are also emphasized as crucial factors in governing the efficiency of solar cells. Electronic parameters for the set of differential equations characterizing transport, recombination, and generation of carriers, and interband and band-bound transition rates, are studied. R.D.V.

A77-30711 * Performance limitations of silicon solar cells. J. R. Hauser (North Carolina State University, Raleigh, N.C.) and P. M. Dunbar (Bucknell University, Lewisburg, Pa.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 305-321. 33 refs. NASA-supported research.

This paper discusses the performance limitations of silicon solar cells which have been identified and investigated using a detailed numerical analysis of solar cell operation. Efficiency limitations are discussed as related to doping densities, minority carrier lifetimes, widths of solar cell regions, surface recombination, antireflecting layers, and ohmic contact stripes. Areas in which improvements can be expected in performance are identified and discussed. (Author)

A77-30714 Optimization of silicon solar cell design for use under concentrated sunlight. D. L. Crook (Intel Corp., Santa Clara, Calif.) and J. R. Yeargan (Arkansas, University, Fayetteville, Ark.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 330-336. 12 refs. Research supported by the University of Arkansas; NSF Grant No. GY-11234.

Design optimization of Si solar cells for a heating system with solar concentrators to reduce costs is discussed. A computer optimization program employing a sequential search technique is developed, based on nine design parameters (junction depth, anti-reflection coating thickness, grid strip width, contact strip width, grid strip separation, grid strip length, wafer thickness, doping concentrations on both sides of junction), and involving losses from recombination, series resistance, contact coverage, and reflection. Collection efficiency is to be maximized for operation at low intensities, series resistance is to be minimized for operation at high intensities. The optimum design (for a given range of intensities) can be attained easily with present technology. R.D.V.

A77-30717 Electronic properties of amorphous silicon in solar cell operation. C. R. Wronski (RCA Laboratories, Princeton, N.J.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 351-357. 11 refs. Contract No. E(04-3)-1286.

This paper discusses the operation of amorphous silicon (a-Si) solar cells with efficiencies up to 5.5 per cent, and relates the major new parameters to the electronic properties of a-Si which are highly dependent on the densities of gap centers in this disordered material. The effect of the photoconductivity in intrinsic a-Si on the series resistance of the cell, the quality of a-Si junctions and their ability to transport current densities generated under AM1 illumination are presented. Space-charge densities found in a-Si junctions orders of magnitude lower than previous estimates for glow discharge produced a-Si. The effects of electric field distributions and diffusion lengths of holes on collection efficiencies and cell characteristics and trapping of photogenerated holes are discussed. (Author)

A77-30720 * Efficiency calculations for Al/x/Ga/1-x/As-GaAs heteroface solar cells. A. M. Sekela (Hewlett-Packard Co., Loveland, Ohio), D. L. Feucht, and A. G. Milnes (Carnegie-Mellon University, Pittsburgh, Pa.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 373-380. 25 refs. Grant No. NGR-29-087-021.

A computer-assisted analysis of the Al(x)Ga(1-x)As-GaAs heteroface solar cell is done to find the dependence of cell efficiency on substrate doping level. Assumptions for carrier lifetime needed for the evaluation of efficiency are based on measurements of experimental Al(x)Ga(1-x)As-GaAs heteroface cells. The results show the doping range 10 to the 16th-17th power per cu cm to be the best for heteroface solar cells. Calculations based on a three-halves temperature dependence for lifetimes agree well with early experimental efficiency versus temperature measurements on GaAs cells, but conflict with earlier results for an Al(x)Ga(1-x)As-GaAs heteroface cell. (Author)

A77-30721 **Design analysis of the thin-film CdS-Cu2S solar cell.** A. Rothwarf and A. M. Barnett (Delaware, University, Newark, Del.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 381-387. 22 refs. NSF Grant No. AER-72-03478; Contract No. E(49-18)-2538.

A detailed model of the CdS-Cu2S solar cell was used to analyze design limits of cell configurations based on present laboratory technology. The parameters controlling the short-circuit current, open-circuit voltage, and fill factor are treated. Attainable conversion efficiency of the CdS-Cu2S solar cell extrapolating from the present processing technology is roughly 10 per cent, as compared to a theoretical efficiency of 16 per cent. A similar analysis for a cell using Cd(1-x)Zn(x)S in place of CdS yields an attainable efficiency of 15 per cent and a theoretical efficiency of over 26 per cent. The model identifies those processing parameters which must be improved in order to optimize cell efficiency. (Author)

A77-30722 **Collection efficiency of heterojunction solar cells.** A. De Vos (Nationaal Fonds voor Wetenschappelyk Onderzoek, Laboratorium voor Elektronika en Meettechniek, Ghent, Belgium) and H. J. Pauwels (Gent, Rijksuniversiteit, Ghent, Belgium). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 388-392.

The dependence of the generation efficiency k, the collection efficiency Q, and the current efficiency kQ of a heterojunction solar cell on two semiconductor bandgaps is investigated. It is assumed that the two semiconductors have ideal absorption characteristics. It is shown that a heterojunction solar cell can exhibit a better current efficiency than a homojunction solar cell, if the semiconductor with the larger bandgap is situated at the illuminated side of the junction. (Author)

A77-30723 **Efficiency calculations for thin-film polycrystalline semiconductor Schottky barrier solar cells.** C. Lanza and H. J. Hovel (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 392-396. 12 refs.

Numerical calculations have been made of the effect of grain size on the short-circuit current and the AM1 efficiency of polycrystalline thin film InP, GaAs, and Si Schottky barrier solar cells. Si cells 10 microns thick are at best 8 per cent efficient for 100-microns grain sizes; 25-microns-thick Si cells can be about 10 per cent efficient for this grain size. GaAs cells 2 microns thick can be 12 per cent efficient for grain sizes of 3 microns or greater. (Author)

A77-30728 * **Silicon solar cells by high-speed low-temperature processing.** A. R. Kirkpatrick, J. A. Minnucci, and A. C. Greenwald (Simulation Physics, Inc., Bedford, Mass.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 429-432. Contracts No. F33615-75-C-2006; No. JPL-954289; No. NAS7-100.

A new method for silicon solar cell fabrication is being developed around ion implantation and pulsed electron beam techniques. Cells are fabricated totally in a vacuum environment at room temperature. Major reductions result in the time, energy consumption, and waste material generation associated with solar cell production. Cells to date have exhibited air mass zero efficiencies exceeding 10 percent. (Author)

A77-30729 **Performance of n/+/-p silicon solar cells in concentrated sunlight.** E. L. Burgess and J. G. Fossum (Sandia Laboratories, Albuquerque, N. Mex.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 433-438. 15 refs. Contract No. E(29-1)-789.

Performance data for n(+)-p silicon solar cells operating at illuminations up to 90 suns (9 W per sq cm) and temperatures up to 100 C are presented. Experimental results for 2 sq cm cells with different base resistivities are compared to performances predicted by a numerical device analysis computer code. Excellent agreement between numerical simulation and experiment is observed. For the illumination levels considered, an optimum base resistivity of approximately 0.3 ohm-cm is predicted by the numerical analyses and verified experimentally. The 0.3-ohm-cm cells exhibit conversion efficiencies above 11.8 per cent up to 90 suns with a peak efficiency of 14 per cent at approximately 30 suns. Preliminary results for a large-area (15.2 sq cm) circular cell design are also presented for illuminations up to 60 suns. A peak conversion efficiency of 13.5 per cent is measured for this cell at about 25 suns. (Author)

A77-30730 **Low-cost solar cells based on large-area unconventional silicon.** H. Fischer and W. Pschunder (Telefunken AG, Heilbronn, West Germany). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 438-442. 8 refs. Research supported by the Bundesministerium für Forschung und Technologie.

Experimental results are presented for the application of a new unconventional nonsingle-crystalline silicon material to solar cell fabrication of acceptable efficiency. Square-shaped slices with a cross-sectional area of 5 by 5 cm, 10 by 10 cm, and 11 by 11 cm are realized. The material is boron-doped and is characterized by controlled size and structure of the individual grains. Particular attention is given to solar cell preparation and performance and to material and process optimization. A major advantage of the proposed low-grade material is that it can be created immediately with a square-shaped cross-sectional area, so that material losses due to the preparation of square wafers out of a cylindrical crystal can be avoided. It is also investigated to what extent new processing must be introduced to optimize the efficiency of these new types of solar cells. S.D.

A77-30731 **Silicon solar cells on unidirectionally recrystallized metallurgical silicon.** T. L. Chu, S. S. Chu, K. Y. Duh, and H. I. Yoo (Southern Methodist University, Dallas, Tex.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 442-446. 11 refs. Contract No. E(04-3)-1285.

The deposition of a silicon layer containing a p-n junction on a metallurgical silicon substrate was used in the fabrication of solar cells. The substrate was prepared by unidirectional solidification of purified metallurgical silicon on a graphite plate, and the active region of the solar cell was deposited by thermal reduction of trichlorosilane with hydrogen containing appropriate dopants. The current-voltage characteristics of a number of solar cells were measured in the dark and under illumination. The AM1 efficiency of large-area cells (30 sq cm) was up to 5.5 per cent. When a large-area cell was divided into small-area (5 sq cm) ones, conversion efficiency was found to correlate directly with the dark current-voltage characteristics of, and the structural properties of silicon in, each cell. (Author)

A77-30732 **Fabrication and characterization of thin-film silicon solar cells on alumina ceramic.** T. Warabisako and T. Saitoh (Hitachi, Ltd., Central Research Laboratory, Kokubunji, Tokyo, Japan). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 446-449. 5 refs. Research supported by the Ministry of International Trade and Industry of Japan.

Dendritic silicon layers are prepared on alumina ceramic by melting and regrowing a CVD Si layer with a BSG encapsulation. Thin-films solar cells fabricated by successive deposition of p- and n(+)-Si layers on this dendritic silicon exhibit a conversion efficiency of 2.6 per cent under AM1 illumination. (Author)

A77-30733 **Amorphous silicon solar cells.** D. E. Carlson (RCA Laboratories, Princeton, N.J.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 449-453. 12 refs. Research sponsored by RCA and ERDA.

Amorphous silicon solar cells have been fabricated in several different structures: heterojunctions, p-i-n junctions, and Schottky barrier devices. The procedures used in constructing the various solar cells are discussed, and their photovoltaic properties are compared. At present, the highest conversion efficiency (5.5 per cent) has been obtained with a Schottky barrier cell, and this structure appears to offer the best promise of approaching the estimated efficiency limit of roughly 15 per cent. (Author)

A77-30735 **Indium-tin-oxide-silicon heterojunction photovoltaic devices.** T. Mizrah (Brown, Bovery et Cie. AG, Dattwil, Switzerland) and D. Adler (MIT, Cambridge, Mass.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 458-462. 21 refs. Research supported by the Cabot Solar Energy Fund.

We have fabricated heterojunction photovoltaic devices consisting of RF-sputtered, highly transparent, and conductive indium-tin-oxide (ITO) films deposited onto both amorphous or crystalline Si. The ITO-amorphous-Si devices exhibit photovoltaic energy-conversion efficiencies of the order of 0.01 per cent for the 100-mW/sq cm white light of a tungsten-halogen lamp. However, the relatively high photoresponse of these devices in the blue-UV spectral region leads to a photovoltaic conversion efficiency of approximately 0.5 per cent for monochromatic light of wavelength 400 nm. The ITO-crystalline-Si devices exhibit terrestrial solar-cell efficiencies of the order of 1 per cent. The performance of such a cell strongly depends on the insulating interface oxide layer, on the surface-state density, and on the incident-light intensity. A model for the operation of these devices is presented and shown to be in quantitative agreement with the experimental data. (Author)

A77-30736 **Intensity effects in SnO2-Si heterojunction solar cells.** W. G. Thompson, S. L. Franz, R. L. Anderson (Syracuse University, Syracuse, N.Y.), and O. H. Winn (Atlantic Community College, Mays Landing, N.J.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 463-467. 14 refs. NSF-supported research.

The saturated photocurrent of SnO2-n-Si heterojunction solar cells is found to be linear with illumination intensity up to 30 suns of simulated AM1 irradiation. An interfacial layer at the SnO2-Si junction causes the open-circuit voltage to saturate at a value of light intensity determined by the thickness of this layer. The resistance of this interfacial layer limits the fill factor of these devices. It is shown that the open-circuit voltage depends on an internal diode quality factor rather than on that measured from the terminal I-V characteristics. The internal diode quality factor can be determined from measurements of open-circuit voltage and saturated photocurrent, with illumination intensity as a parameter. (Author)

A77-30738 **Large-area high-efficiency /AlGa/As-GaAs solar cells.** G. S. Kamath, J. Ewan, and R. C. Knechtli (Hughes Research Laboratories, Malibu, Calif.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 473-475. 11 refs. Contract No. F33615-76-C-2121.

An improved technique for making large-area high-efficiency (AlGa)As-GaAs solar cells is described. This includes a modified infinite melt liquid phase epitaxial process, for growing the desired (AlGa)As-GaAs and GaAs layers. Representative solar cells fabricated in this manner are described. Performance with an air mass zero efficiency in excess of 16 per cent is shown, for cells of a 4 sq cm area. Means are shown for increasing this efficiency to about 18 per cent. (Author)

A77-30739 * **Technology of GaAs metal-oxide-semiconductor solar cells.** R. J. Stirn and Y. C. M. Yeh (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 476-483. 14 refs. Contract No. NAS7-100.

The growth of an oxide interfacial layer was recently found to increase the open-circuit voltage (OCV) and efficiency by up to 60 per cent in GaAs metal-semiconductor solar cells. Details of oxidation techniques to provide the necessary oxide thickness and chemical structure and using ozone, water-vapor-saturated oxygen, or oxygen gas discharges are described, as well as apparent crystallographic orientation effects. Preliminary results of the oxide chemistry obtained from X-ray, photoelectron spectroscopy are given. Ratios of arsenic oxide to gallium oxide of unity or less seem to be preferable. Samples with the highest OVC predominantly have As(+3) in the arsenic oxide rather than As(+5). A major difficulty at this time is a reduction in OCV by 100-200 mV when the antireflection coating is vacuum deposited. (Author)

A77-30740 **InP-CdS solar cells.** J. L. Shay, S. Wagner (Bell Telephone Laboratories, Inc., Holmdel, N.J.), M. Bettini, K. J. Bachmann, and E. Buehler (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 483-486. 10 refs.

We report single crystal InP-CdS solar cells having AM2 efficiencies of 15 per cent and polycrystalline thin-film cells having AM2 efficiencies of 5.7 per cent. Basic studies of the interface reveal that the thin-film efficiency is presently limited at least in part by the quality of the InP within the grains, and not exclusively by interface phenomena intrinsic to a polycrystalline cell. Preliminary accelerated life tests indicate a remarkable insensitivity of these unencapsulated cells to the ambient. (Author)

A77-30741 **Photovoltaic energy conversion with n-CdS-p-CdTe heterojunctions and other II-VI junctions.** R. H. Bube, F. Buch, A. L. Fahrenbruch, Y. Y. Ma, and K. W. Mitchell (Stanford University, Stanford, Calif.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 487-492. 25 refs. NSF-supported research.

n-CdS-p-CdTe heterojunctions have been prepared by close-spaced vapor transport of p-CdTe films onto single crystal n-CdS, by vacuum evaporation of n-CdS films onto single crystal p-CdTe, and by solution spraying of n-CdS films onto single crystal p-CdTe. In addition, a number of other II-VI p-n heterojunctions have been prepared by the close-spaced vapor transport technique. The highest solar efficiency to date has been obtained with a cell prepared by vacuum evaporation of n-CdS film onto p-CdTe crystal, in which the CdS is covered with an indium-tin-oxide coating and then with an antireflection coating; the photovoltaic parameters of this cell are an open-circuit voltage of 0.63 V, a quantum efficiency of 0.82, a fill factor of 0.66, and a solar efficiency of 7.9 per cent. II-VI heterojunction cells with efficiency greater than 10 per cent are expected in the near future. (Author)

A77-30742 **Semiconductor-electrolyte photovoltaic cells employing CdSe and CdTe.** Y. G. Chai, L. B. Anderson (Ohio State University, Columbus, Ohio), and W. W. Anderson (Lockheed Research Laboratories, Palo Alto, Calif.). *IEEE Transactions on Electron Devices,* vol. ED-24, Apr. 1977, p. 492-496. 18 refs. NSF Grant No. AER-74-13292.

Cadmium selenide and cadmium telluride have been studied in photovoltaic cells constructed of single crystal semiconductor materials in contact with electrolyte solutions. Cadmium selenide shows an open-circuit voltage near 0.8 V and power conversion efficiencies near 6 percent for 720-nm light. The CdTe cells did not show current-voltage characteristics favorable for solar cell application. Formation of a surface film of tellurium apparently degrades the photovoltaic properties on illumination. (Author)

A77-30812 **Optimal unit commitment.** A. Turgeon (Hydro-Quebec Institute of Research, Varennes, Canada). *IEEE Transactions on Automatic Control,* vol. AC-22, Apr. 1977, p. 223-227. 20 refs.

The paper describes a new and rigorous method for determining the mode of operation of an electrical power system that minimizes the operational cost. The power system consists of M thermal generating units and one constant-head hydroplant. The operational cost includes the fixed and variable start-up and running costs of the thermal units. The method uses the maximum principle of Pontryagin to determine the generation levels of the operating units, to devise additional criteria for fathoming a vertex in the branch and bound algorithm, and to reduce the number of units considered for shut down. The choice of which units to shut down from those suggested by the maximum principle is done by branch and bound. (Author)

A77-31044 **Optimization of composite flywheel design.** E. L. Danfelt, S. A. Hewes, and T.-W. Chou (Delaware, University, Newark, Del.). *International Journal of Mechanical Sciences,* vol. 19, Feb. 1977, p. 69-78. 12 refs.

Composite flywheels are effective energy storage devices. The multi-rimmed flywheel configuration is first chosen for this study because of its superior operating characteristics and versatility. Then the Kevlar-49/epoxy system is adopted as the basic composite material, which is sandwiched between thin layers of rubber. A general stress analysis procedure is developed for the multi-rimmed structure and a computer routine is established to investigate the effects of various material and geometric parameters on the internal stress levels. A maximum stress criterion is used for failure of the composite flywheel. The basic goal of optimization is to achieve a stress distribution such that each ring in the multi-ringed structure will fail at approximately the same angular speed. The parameters varied in the optimization process include the thickness, Poisson's ratio, Young's modulus and density of the inter-ring material, the density and thickness of the composite material, and the thickness of the flywheel in the axial direction. The optimization process demonstrated that this procedure can be applied in general when other failure criteria or performance characteristics (such as maximum kinetic energy, kinetic energy per weight and kinetic energy per volume) are preferred. (Author)

A77-31064 **Report on Joint Conference Eno Foundation Board of Directors and Board of Consultants, October 13 and 14, 1976.** *Traffic Quarterly,* vol. 31, Apr. 1977, p. 175-274. 67 refs.

In October 1976 the Eno Foundation Board of Directors and Board of Consultants participated in a two-day conference which consisted of a series of panel presentations followed by group discussion. The outline of subjects for the first day covers Transportation Systems of the Future - The Federal role (for different modes of transportation), The roles of state and local governments, and Modal viewpoints - industry; and for the second day, The Economics of Environmental Protection in Transportation - Defining the problem (for different modes of transportation), Federal regulation and requirements, and State and local regulations. M.L.

A77-31171 **Anodic oxidation of ethylene glycol with noble metal alloy catalysts.** H. Kohlmüller (Siemens AG, Forschungslaboratorien, Erlangen, West Germany). *Journal of Power Sources,* vol. 1, Apr. 1977, p. 249-256. *Research supported by the Bundesministerium der Verteidigung.*

Current-voltage curves showing the corrosion of platinum-lead alloys in 6 M KOH were obtained, taking into account the intermetallic compound Pt3Pb. The activity of Raney-platinum and platinum-lead alloys is discussed. Attention is given to the determination of the apparent energy of activation, the determination of the current function, and platinum-lead catalysts in fuel cell electrodes. G.R.

A77-31173 **Influence of bonding and filling agents on the activity of tungsten carbide hydrogen electrodes.** M. Svata (Czechoslovak Academy of Sciences, Institute of Physical Chemistry and Electrochemistry, Prague, Czechoslovakia) and S. Rudolf (Dresden, Technische Universität, Dresden, East Germany). *Journal of Power Sources,* vol. 1, Apr. 1977, p. 277-284. 7 refs.

In the reported investigation a series of electrodes were made from tungsten carbide samples, which differed with regard to purity, grain size, structure, and surface area. The catalysts were bonded with polytetrafluoroethylene or polyethylene. Filling agents used to increase the pore volume include (COOH)2, (NH4COO)2, KHCO3, NH4HCO3, NH4NO3, NH4Cl, KCl, and Na2SO4. G.R.

A77-31244 **Applications of thin graded-index films to solar absorbers.** I. T. Ritchie and B. Window (Sydney, University, Sydney, Australia). *Applied Optics,* vol. 16, May 1977, p. 1438-1443. 21 refs. Research supported by the Australian Research Grants Committee and University of Sydney.

The solar absorptance of a single ideal film on an idealized metallic substrate has been calculated as a function of its optical constants to determine the optimum parameters for selective absorber applications. High normal solar absorptances (above 0.9) are possible for single uniform interference films if n is less than 1.5 and k is greater than 0.2 and less than 0.8, values that are achievable using cermet materials. The parameters n and k are the real and imaginary parts of the refractive index. Grading the refractive index of single interference films improves the absorptance, with optimum results given by a uniformly increasing dielectric constant through the layer. With such a linear grading to air, normal solar absorptances of greater than 0.9 can be achieved for n below 1.5 and k between 0.1 and 5. Grading an absorbing material with a dielectric also improves the performance of the absorbing material. For bulk films, the optimum profile with minimum material is one where the dielectric constant increases slowly at the surface of the film. (Author)

A77-31245 **Lighting with sunlight using sun tracking concentrators.** M. A. Duguay (Bell Telephone Laboratories, Inc., Holmdel, N.J.) and R. M. Edgar (Sandia Laboratories, Albuquerque, N. Mex.). *Applied Optics,* vol. 16, May 1977, p. 1444-1446. 8 refs. ERDA-supported research.

The use of controlled beams of sunlight for lighting interior parts of a building is proposed as an economically attractive and practical option in a solar context. Sun tracking concentrators introduce beams of sunlight through holes in the roof. Inside, the beams can be relayed throughout the building by means of mirrors and lenses. Ideally cool lighting is obtained by using dielectric mirrors to separate the visible and IR parts of the solar spectrum. The IR can be used to generate electricity and usable heat in solar cells. Results of a preliminary experiment are given. (Author)

A77-31262 * **Analysis of steranes and triterpanes in geolipid extracts by automatic classification of mass spectra.** A. M. K. Wardroper, P. W. Brooks, M. J. Humberston, and J. R. Maxwell (Bristol, University, Bristol, England). *Geochimica et Cosmochimica Acta,* vol. 41, Apr. 1977, p. 499-510. 41 refs. Research supported by the Nuffield Foundation; Natural Environment Research Council Grant No. GR/3/2420; Grant No. NGL-05-003-003.

A computer method is described for the automatic classification of triterpanes and steranes into gross structural type from their mass spectral characteristics. The method has been applied to the spectra obtained by gas-chromatographic/mass-spectroscopic analysis of two mixtures of standards and of hydrocarbon fractions isolated from Green River and Messel oil shales. Almost all of the steranes and triterpanes identified previously in both shales were classified, in addition to a number of new components. The results indicate that classification of such alkanes is possible with a laboratory computer system. The method has application to diagenesis and maturation studies as well as to oil/oil and oil/source rock correlations in which rapid screening of large numbers of samples is required. (Author)

A77-31371 # **Solar energy can be self-supporting long-term energy storage.** R. F. Benseman (Department of Scientific and Industrial Research, Physics and Engineering Laboratory, Lower Hutt, New Zealand). *New Zealand Energy Journal*, vol. 50, Feb. 25, 1977, p. 17, 18.

The problem of long-term storage of collected solar energy is considered. Storage media discussed include water, graded rock or gravel, and salt hydrates (for latent-heat storage). It is suggested that the scale of storage be increased so that energy collected during the favorable summer months can be used in winter. Applications to individual houses are evaluated along with the possibility of combining the relatively small stores of individual houses into a single store to be shared by a number of them. Additional advantages of shared storage are briefly noted. F.G.M.

A77-31372 **The law for saving energy and its significance for energy politics (Das Energieeinsparungsgesetz und seine Bedeutung für die Energiepolitik).** G. Krink (Bundesministerium für Wirtschaft, Bonn, West Germany). *(Norddeutsche Fachtagung über Brauchwasserwärmung im Hochbau, Planungsgrundlagen - energiesparende Systemlösungen, Bremen, West Germany, Nov. 9, 1976.) HLH - Zeitschrift für Heizung, Lüftung, Klimatechnik*, vol. 28, Apr. 1977, p. 132-134. In German.

An evaluation is conducted of the significance of the West German law of July 1976 for the saving of energy. The law has the objective to reduce energy losses related to the heating of buildings. An economical compensation for the additional investment costs which arise in connection with this law is to be provided by the reduction in heating costs which will be obtained as a consequence of the investment. It is pointed out that the law affects essentially only new buildings with 300,000 to 400,000 apartments per year. In theory, it would be possible to save energy also in the case of old apartments. However, structural differences of old buildings in West Germany make it difficult to prescribe by law economically justifiable investments. G.R.

A77-31373 **Energy savings by application of knowledge of building physics. I - Wall permeability and its significance for the atmospheric conditions in the building interior, the design and the thermal characteristics of windows, problems concerning the permeability of the joints (Energieeinsparung durch Anwendung von Erkenntnissen der Bauphysik. I - Wanddurchlässigkeit und ihre Bedeutung für die Luftzustände im Gebäudeinnern, Konstruktion und wärmetechnisches Verhalten von Fenstern, Problematik der Fugendurchlässigkeit).** H. Reinders. *HLH - Zeitschrift für Heizung, Lüftung, Klimatechnik*, vol. 28, Apr. 1977, p. 135-140. In German.

An investigation is conducted of the various factors which have to be taken into account in the design of buildings, rooms, and heating systems which will provide optimum conditions with respect to the heating requirements and the physiological requirements of the occupants. The amount of oxygen needed by a person is considered, taking into account various physiological and activity conditions, the environmental temperature, and aspects of oxygen concentration. Regulations which are to assure satisfactory physiological conditions for the occupants of a room are examined. Attention is given to an exchange of air between the building exterior and interior by means of diffusion processes and the significance of this exchange. Aspects of heat transfer through windows are discussed. Numerical relations are provided regarding the external air volume needed to prevent an excessive carbon dioxide concentration in the room. G.R.

A77-31374 **Economy of tap water heating in summer by means of solar energy (Wirtschaftlichkeit der Sommer-Brauchwassererwärmung mit Solarenergie).** A. Dittrich (Gesellschaft zur Förderung der Heizungs- und Klimatechnik mbH, Düsseldorf, West Germany). *HLH - Zeitschrift für Heizung, Lüftung, Klimatechnik*, vol. 28, Apr. 1977, p. 141-144. 5 refs. In German.

An investigation is conducted concerning the energy quantity which can be obtained by means of solar energy during the summer in the case of a one-family house with a heated residential area of 140 sq m. Two cases are considered, including a new building designed according to the regulations of the law for the saving of energy in West Germany and a currently existing building from the year 1970 without special insulation properties. The investigation shows that the energy consumption for tap water heating during the time from April 1 to September 30 is for the considered case much lower than it is generally assumed. The significance of the savings possible by a use of solar energy appears not very significant. G.R.

A77-31375 **Optimal tap water heating (Optimale Brauchwassererwärmung).** C. Kittel. *(Norddeutsche Fachtagung über Brauchwasserwärmung im Hochbau, Planungsgrundlagen - energiesparende Systemlösungen, Bremen, West Germany, Nov. 9, 1976.) HLH - Zeitschrift für Heizung, Lüftung, Klimatechnik*, vol. 28, Apr. 1977, p. 152-156. In German.

Developments in the area of tap water heating devices during the last ten years have led to the design of systems with optimum energy utilization characteristics. The systems are generally based on a use of solid fuels, oil, gas, or electricity. The law for the saving of energy in buildings in West Germany has recently directly affected the system technology and the design of the devices. A description is presented of the various types of tap water heating systems used, taking into account direct and indirect heating methods. Attention is given to aspects of temperature limitation, storage considerations, the use of suitable insulation for an economic operation, and the advantages of an employment of a glass-like coating on the metallic base material. G.R.

A77-31426 **High-power systems with ac generators and inertial storage banks for electrophysical devices.** I. A. Glebov, E. G. Kasharskii, N. N. Kustov, and F. G. Rutberg (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Elektromashinostroeniia, Leningrad, USSR). *(Pis'ma v Zhurnal Tekhnicheskoi Fiziki*, vol. 2, June 12, 1976, p. 496-500.) *Soviet Technical Physics Letters*, vol. 2, June 1976, p. 194, 195. 5 refs. Translation.

The paper discusses some of the physical requirements of high-power energy sources, consisting of a synchronous generator and a flywheel, for supplying electromechanical loads to the magnet systems of, for example, Tokamak devices. Based on a formula for the highest permissible velocity of points at the periphery of the flywheel in terms of specific strength and structural features of the flywheel, a nomogram is given, from which one can determine flywheel weight, maximum radius, and length for given required stored energies. P.T.H.

A77-31467 **Alternative energy sources.** Edited by J. P. Hartnett (Illinois, University, Chicago, Ill.). New York, Academic Press, Inc.; Washington, D.C., Hemisphere Publishing Corp., 1976. 335 p. $28.50.

The place and role of various energy resources in energetics of the future is considered along with the case for alternative energy sources, energy development and related UNESCO activities, applications of fluidized beds in coal technology, coal gasification, and solar-thermal energy systems. Attention is also given to the French CNRS 1000 kW solar furnace, solar-thermal power systems, heat and mass transfer in the earth, and the present and future of geothermal power utilization. G.R.

A77-31468 **Place and role of various energy resources in energetics of the future.** M. A. Styrikovich (Academy of Sciences, National Committee for Heat and Mass Transfer, Moscow, USSR). In: Alternative energy sources. New York, Academic Press, Inc.; Washington, D.C., Hemisphere Publishing Corp., 1976, p. 1-17.

An evaluation is conducted regarding the significance of various sources of energy, taking into account the situation during the first three quarters of the 20th century and future developments. Estimates are obtained concerning the main categories of the world energy sources, giving attention to oil, natural gas, coal, nuclear fuel, solar energy, hydraulic resources, geothermal resources, and power resources related to the energy of wind, tide, sea current, and waves. Developments concerning the growth in energy demand are considered and energy supply prospects are investigated. G.R.

A77-31469 **The case for alternative energy sources.** J. P. Hartnett (Illinois, University, Chicago, Ill.). In: Alternative energy sources. New York, Academic Press, Inc.; Washington, D.C., Hemisphere Publishing Corp., 1976, p. 19-38. 9 refs.

World energy consumption patterns are examined and the fuels used for energy during the time from 1950 to 1970 are considered. An investigation is conducted regarding the distribution of energy resources, taking into account reserves of natural gas and oil, coal resources, peat resources, oil shale and bituminous sands, uranium reserves, hydro resources, geothermal resources, solar energy, tidal power, wind power, and ocean thermal gradients. Attention is also given to postembargo energy projections and the energy program in the U.S. G.R.

A77-31470 **Applications of fluidized beds in coal technology.** A. M. Squires (City College, New York, N.Y.). In: Alternative energy sources. New York, Academic Press, Inc.; Washington, D.C., Hemisphere Publishing Corp., 1976, p. 59-109. 40 refs. Research supported by the Empire State Electric Energy Research Corp.; NSF Grant No. AER-72-03426-4.

Particulate and aggregative fluidization is considered and questions regarding the contrast between the behavior of fine and coarse powders are investigated. Attention is given to analogies with aerated pools of a liquid; the cocurrent upflow of air and water, the turbulent and fast fluidization of a group A solid, the fast fluidized bed calciner of a company in West Germany, studies of fast fluidization carried out at the City University of New York, data reported by Lanneau (1960) concerning the instantaneous point density of a fluidized cracking catalyst, heat transfer in a fast fluidized bed, the kinetics of the gasification of coal in a fluidized bed, species of fluidization, and details of fluidized bed combustion. G.R.

A77-31471 **Coal gasification.** K. Hedden (Karlsruhe, Universität, Karlsruhe, West Germany). In: Alternative energy sources. New York, Academic Press, Inc.; Washington, D.C., Hemisphere Publishing Corp., 1976, p. 111-148. 6 refs.

One of the two gasification processes is based on the destructive distillation of coal. In this carbonizing process the greater part of the volatile matter of the coal is driven off and coke is left as a by-product. In the second process gas is produced by gasifying coke residues of the carbonization process with steam, carbon dioxide, oxygen, air, hydrogen, or mixtures of these gases. Aspects of process stoichiometry and thermochemistry are discussed along with the chemical equilibrium, chemical kinetics, and the influence of mass transfer. A description is presented of the types of gasification processes and yield reactions. Conventional gas producers are considered and new developments in gasification are examined. G.R.

A77-31472 **Solar-thermal energy systems.** E. M. Sparrow and R. B. Sparrow (Minnesota, University, Minneapolis, Minn.). In: Alternative energy sources. New York, Academic Press, Inc.; Washington, D.C., Hemisphere Publishing Corp., 1976, p. 149-182. 16 refs.

The characteristics of insolation which have to be considered in an assessment of the potential for solar energy devices at a geographical location are examined. A thermal analysis of flat-plate collectors is conducted, taking into account a qualitative description, the collector energy gain and fluid temperature rise, and the mathematical relations concerning the heat losses. Attention is also given to flat-plate collector performance results, thermal storage, and space conditioning systems. G.R.

A77-31473 **The French CNRS 1000 kW solar furnace - Description, performance characteristics, present utilization, and perspectives.** F. Trombe, A. Le Phat Vinh, and C. Royere (CNRS, Laboratoire de l'Energie Solaire, Font Romeu, Pyrénées-Orientales, France). In: Alternative energy sources. New York, Academic Press, Inc.; Washington, D.C., Hemisphere Publishing Corp., 1976, p. 183-217. 21 refs.

A77-31474 **Solar-thermal power systems.** J. C. Denton (American Technological University, Killeen, Tex.). In: Alternative energy sources. New York, Academic, Press, Inc.; Washington, D.C., Hemisphere Publishing Corp., 1976, p. 219-243. 18 refs.

The characteristics of the solar energy source are examined, taking into account the solar-energy spectrum at sea level and outside the atmosphere, diurnal and seasonal variations, and direct and indirect radiation. The energy contained in the solar flux can be collected if it is allowed to fall on a suitable collector. A description is presented of focusing and nonfocusing thermal collectors. Approaches for storing the thermal energy from the collectors are discussed, giving attention to thermal-energy storage and chemical energy storage. Electric power utility considerations are also explored. G.R.

A77-31475 **Geothermal power utilization, present and future.** V. K. Jonsson (University of Iceland, Reykjavik, Iceland). In: Alternative energy sources. New York, Academic Press, Inc.; Washington, D.C., Hemisphere Publishing Corp., 1976, p. 279-324. 22 refs.

Developments in Iceland are discussed as an example for geothermal power utilization in the case of a country which has large resources of hydro and geothermal energy. The geology of Iceland is considered along with the chemistry of the thermal water, a diatomite plant, greenhouses heated by natural hot water, fish farming, seaweed drying, freeze drying, the Reykjanes salt plant, a magnesium project, heavy-water production, and recreational and health applications. Attention is given to aspects of geothermal power generation and the district heating system in Iceland. G.R.

A77-31487 **Raman scattering and the characterisation of atmospheric aerosol particles.** H. Rosen and T. Novakov (California, University, Berkeley, Calif.). *Nature*, vol. 266, Apr. 21, 1977, p. 708-710. 5 refs. ERDA-NSF-supported research.

Experiments to demonstrate the feasibility of characterizing particulate pollutants by means of Raman spectroscopy are described. Samples included diesel exhaust particles, automobile exhaust particles, and several ambient air samples. Spectra from these samples were compared with those of polycrystalline graphite and activated carbon. The results indicate that physical structures similar to activated carbon are at least a major species and may be the dominant species in both source-enriched and ambient samples. P.T.H.

A77-31534 **Evaporation of a drop of solution in a high-temperature medium.** A. M. Golovin (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR) and V. R. Pesochin (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *(Teplofizika Vysokikh Temperatur,* vol. 14, July-Aug. 1976, p. 814-822.) *High Temperature,* vol. 14, no. 4, Jan. 1977, p. 720-727. 26 refs. Translation.

The evaporation of an isolated droplet of an aqueous solution of potassium carbonate in combustion products of a fuel gas is analyzed. It is shown that the droplet goes through the following stages: heating; evaporation of water, accompanied by the formation of a saturated solution; evaporation of this solution, accompanied by the formation of a solid phase; heating and melting of the solid phase; and finally heating and evaporation of the liquid potassium carbonate. Semiempirical formulas are proposed for calculating the drag coefficient and Nusselt number in the motion of an evaporating droplet. Evaporation and melting are calculated in a quasi-steady approximation. V.P.

A77-31538 **Effect of various losses on the characteristics of powerful MHD generators.** V. A. Bitiurin, P. P. Ivanov, V. I. Kovbasiuk, and G. M. Koriagina (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *(Teplofizika Vysokikh Temperatur,* vol. 14, July-Aug. 1976, p. 846-852.) *High Temperature,* vol. 14, no. 4, Jan. 1977, p. 748-753. 9 refs. Translation.

The hydrodynamic characteristics of MHD flow are discussed for generators of the type used in 1000 MW open-cycle power plants. Detailed attention is given to the influence on the output characteristics of electrodynamic effects associated with the nonuniformity of the flow in boundary layers, the electrode phenomena, the nonuniformity of conductivity across the channel, the Hall effect in flows with a nonuniform conductivity, and end effects. The analysis is aimed at identifying basic errors in conventional (quasi-one-dimensional) computations of the gasdynamic and electric characteristics of MHD flows, and the causes of the errors. The need to thoroughly analyze the influence of conductivity nonuniformity and to optimize the flow conditions is pointed out. V.P.

A77-31540 **Calculation of thermal stresses in ceramic elements of the refractory channel walls of a magnetohydrodynamic generator.** A. M. Dubasov (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *(Teplofizika Vysokikh Temperatur,* vol. 14, July-Aug. 1976, p. 872-880.) *High Temperature,* vol. 14, no. 4, Jan. 1977, p. 771-778. 6 refs. Translation.

A method is proposed for calculating thermal stresses in ceramic solid and multilayer plates and in ceramic cylinders of finite length. The temperature field is assumed to vary only over the plate thickness or the cylinder length. The thermal stresses in plates are calculated with allowance for the temperature dependence of the modulus of elasticity and for the stress-strain state. Stresses in cylinders are calculated for a constant modulus of elasticity, in the form of polynomials of the radial and axial coordinates. The solution satisfies rigorously the compatibility and equilibrium equations and the boundary conditions at one end. The method is illustrated by examples. V.P.

A77-31572 **Energy policies of France, Britain, and Germany compared (Les politiques énergétiques comparées de la France, de l'Angleterre et de l'Allemagne).** G. de Carmoy (Institut Européen d'Administration d'Affaires, Fontainebleau; Paris, Institut d'Etudes Politiques, Paris, France). *Revue de l'Energie,* vol. 28, Mar. 1977, p. 160-164. 5 refs. In French.

Recent changes in the energy policies of France, Britain, and Germany in response to the rise in petroleum prices, presented imported fuel volume, and available coal reserves (hard coal, soft coal, lignite, gasifiable) are examined. Coal reserves in the several forms of occurrence of coal are reviewed separately for each of the three industrial powers. Factors limiting the production of west European coal are isolated: rises in production costs and labor costs; limited capacity of existing power plants. Construction of modernized coal-fired power plants is seen as crucial. R.D.V.

A77-31573 **Equivalence of electricity and fuels - Contributing elements to a critical discussion (Equivalences entre électricité et combustibles - Eléments pour une discussion critique).** P. Ramain (CNRS, Institut Economique et Juridique de l'Energie, France). *Revue de l'Energie,* vol. 28, Mar. 1977, p. 165-174. 10 refs. In French.

Definition and selection of a useful concept of equivalence between electricity and fuel to be consumed in generating electricity are explored. Adequacies and inadequacies of various approaches for arriving at equivalents of electric power and fuels, prompt determination of an equivalence coefficient, the concept of 'equal rendered service', and calculations of equivalence coefficients are dealt with. Applications to electricity per se, and to other forms of energy and energy generation and transmission are considered (heat pump, nuclear power, coal-fired power generation, hydroelectric power, heat generated). R.D.V.

A77-31574 **Energy and natural resources (Energie et ressources naturelles).** M. Grenon. *Revue de l'Energie,* vol. 28, Mar. 1977, p. 175-182. In French

Applications of the WELMM (water, energy, land, materials, manpower) method to analysis of available natural sources are studied as a complement to existing economic analysis techniques. Use of WELMM as a tool in energy accounting, and studies of the availability of, mutual interaction of, and consumer demands on, natural resources, is considered. Specific applications discussed include: energy analysis of a production offshore oil well in the North Sea, interaction between natural resources in an energy chain (generation of electric power by nuclear fuel or fossil fuel), generation of electric power from coal combustion, and generation of electric power by nuclear means. R.D.V.

A77-31576 **Gas economy - Gas technology (Gaswirtschaft - Gastechnik).** E. Scholand (Ruhr-Universität, Bochum, West Germany). *Brennstoff-Wärme-Kraft,* vol. 29, Apr. 1977, p. 128-131. 122 refs. In German.

Economic developments concerning the use of natural gas in West Germany are considered along with questions related to the available natural gas reserves, technological aspects concerning the distribution and transportation of natural gas with the aid of pipelines and ships designed for such applications, and the importation of gas from the Netherlands, Norway, Iran, the Soviet Union, and China. The use of natural gas in the German industry is discussed, taking into account a utilization in the iron and steel industry and a use for the generation of electric power. Attention is also given to a use of gas in private households, questions of safety and environmental protection, and the possibility to replace natural gas with gas obtained by the gasification of coal. G.R.

A77-31577 **Regenerative energy sources (Regenerative Energiequellen).** M. Meliss (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). *Brennstoff-Wärme-Kraft,* vol. 29, Apr. 1977, p. 136-142. 63 refs. In German.

The significance of the various primary energy sources with respect to a utilization in West Germany is examined. In the case of geothermal energy, it is found that the current possibilities concerning a use of this energy source in West Germany are very limited. The feasibility to utilize solar radiation is also investigated. It is estimated that about 100% of the hydroelectric power potential in West Germany will be utilized in 1985. However, there might be possibilities for technology export in connection with currently not exploited water power resources outside Germany. The large-scale

utilization of the available wind energy depends on the solution of energy storage problems. Attention is also given to heating systems utilizing heat pumps and the employment of flat plate solar energy collectors. G.R.

A77-31578 Efficient energy utilization (Rationelle Energieverwendung). K. F. Ebersbach and G. Layer (Forschungsstelle für Energiewirtschaft, Munich, West Germany). *Brennstoff-Wärme-Kraft*, vol. 29, Apr. 1977, p. 149-151. 33 refs. In German.

A description is presented of investigations which have been conducted in West Germany with the objective to explore possibilities concerning a saving of energy by various approaches. Attention is given to the improvement of the efficiency of energetic process, the reduction of the energy intensity in the case of household devices, the possibilities for a utilization of waste heat, the use of heat-pump heating systems, the utilization of solar energy for heating and hot-water supply applications, and approaches to save fuel in motor-vehicle operation. G.R.

A77-31579 Energy storage (Energiespeicherung). G. Eisenmann and E. Hahne (Stuttgart, Universität, Stuttgart, West Germany). *Brennstoff-Wärme-Kraft*, vol. 29, Apr. 1977, p. 151-154. 114 refs. In German.

A literature review is provided concerning publications which are related to approaches for the storage of energy. Attention is given to the storage of oil and coal, gas storage in tanks and underground locations, energy storage with the aid of flywheels, the storage of energy as potential energy in the form of water pumped to a higher level, short-term and long-term thermal energy storage in containers, compressed air storage, heat storage systems for air conditioning, packed bed thermal storage systems for solar air heating and cooling systems, adsorbent energy storage beds, a solar pond for space heating, latent heat storage systems, the use of chemical reactions for energy storage, and various types of secondary storage batteries. G.R.

A77-31595 Energy demands: Modeling methods and techniques (La demande d'énergie: Méthodes et techniques de modélisation). J. Girod. Paris, Centre National de la Recherche Scientifique, 1977. 190 p. 197 refs. In French. $8.00.

Review, classification, analysis, and critique of the vast range of models advanced to account for the amplitude and variations of energy demands on global and local scales are addressed. The need for structuring of energy demand models is taken into cognizance. Chapter headings include: energy demand models; total energy consumption; energy consumption by sector, by form of energy, by use; energy demand - price and equipment; models, energy costs, and calculation of econometric elasticity; models for distribution of parts of the market; power equipment and calculation of substitutable demand; KLEM (capital-labor-materials-energy) models; optimization and simulation models. R.D.V.

A77-31673 Thermal accumulators. P. W. O'Callaghan and S. D. Probert (Cranfield Institute of Technology, Cranfield, Beds., England). *Applied Energy*, vol. 3, Jan. 1977, p. 51-64.

A preliminary guide is developed for an initial assessment of sensible- and latent-heat storage systems for short-term and long-term applications. Insulant efficiency, stratification effects and the transient and periodic behavior of the store medium and its auxiliaries should be considered in greater depth once the store capacity as a primary design parameter has been chosen. Design charts relating storage volume, thermal capacity, boundary insulant thickness and time constant are provided. S.D.

A77-31674 Fluidisation and gas combustion in a rotating fluidised bed. C. I. Metcalfe and J. R. Howard (Aston, University, Birmingham, England). *Applied Energy*, vol. 3, Jan. 1977, p. 65-74. 19 refs. Research supported by the National Research Development Corp.

The background against which this novel type of high intensity combustor is being developed is described. Some of the design, development and operating problems involved are reported. Conditions for satisfactory fluidization of the particles and combustion of propane within a rotating fluidized bed are outlined. Running experience shows that stable, complete combustion of propane can be sustained at intensities exceeding 85 MW/cu m of bed particles when a centripetal acceleration of ten times gravity is applied to a shallow bed of particles without an unacceptable pressure drop. (Author)

A77-31698 Thermal energy storage. M. N. Bahadori. *Iranian Journal of Science and Technology*, vol. 5, no. 4, 1976, p. 159-171. 26 refs.

Thermal energy storage using sensible heating and physical and chemical changes are considered. The sensible heating process includes the storage in building elements, water, and rock beds. Advantages and disadvantages of each are given. Thermal energy storage through physical changes including solid-solid, solid-liquid, and liquid-vapor transitions are discussed with more emphasis placed on the fusion of salt-hydrates. The chemical change thermal storage includes a number of chemical reactions. The intermediate and long-term thermal energy storages include the use of swimming pools, solar ponds, caves, cisterns and wells. It is concluded that water is the best medium for thermal energy storage for heating and cooling of buildings. (Author)

A77-31750 * Accelerated heat-aging studies on fluororubber in various media. S. H. Kalfayan, R. H. Silver, and S. S. Liu (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Rubber Chemistry and Technology*, vol. 49, Sept.-Oct. 1976, p. 1001-1009. 12 refs. Contract No. NAS7-100.

Heat-aging studies were conducted on fluororubber (copolymers of vinylidene fluoride and perfluoropropylene) using N,N-dicinnamylidene-1,6-hexanediamine, a Schiff's base of 1,6-hexanediamine, and MgO as acid acceptor. The principal technique employed was chemical stress relaxation for determining network changes brought about in the heat-aged fluororubber. This technique was backed up by swelling measurements, gel permeation chromatography, and IR spectroscopy. Stress relaxation curves are plotted for a wide range of variation in parameters (time, crosslinking density, state of curing, temperature, intermittent and continuous relaxation). R.D.V.

A77-31823 Spectral response and efficiency relations in semiconductor liquid junction solar cells. A. Heller, K. C. Chang, and B. Miller (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). *Electrochemical Society, Journal*, vol. 124, May 1977, p. 697-700. 12 refs.

States due to imperfections at or near surfaces of semiconductors in liquid junction solar cells can be identified by changes in the photoresponse spectra under short-circuit current conditions. These effects become dominant features in two-beam experiments with an intense pumping (laser) source and a weak modulated probing beam. The presence of these states can be correlated with drastic decreases in short-circuit currents, open-circuit voltages, fill factors, and maximum power conversion efficiencies of the cells. Elimination of the damaged surface regions by suitable etching allows AM2 solar conversion efficiencies of 1.3 and 7.2%, respectively, in the cells n-CdS/0.1F Na2S-0.02F S-0.1F NaOH/C and n-CdSe/1F Na2S-1F S-1F NaOH/C. (Author)

A77-31825 Potential energy: An analysis of world energy technology. M. Kenward. Cambridge and New York, Cambridge University Press, 1976. 236 p. $14.95.

General conditions concerning the available energy sources for the world's economy are examined, taking into account the growth in world energy consumption over the period from 1962 to 1972. New uses of coal are considered along with aspects of gasification and liquefaction. Prospects concerning a use of nuclear fission are investigated, taking into account thermal reactors, breeder reactors, the fuel cycle, waste management, reactor safety, nuclear process heat, and fuel transformations. Attention is also given to oil resources, oil shales, tar sands, fusion, solar power, geothermal energy, wind power, the utilization of the tides, and questions related to an efficient use of available fuels. G.R.

A77-31849 # **The role of gas utilization in environmental protection (A gazfelhasznalas szerepe a kornyezetvedelemben).** F. Moticska (Orszagos Koolaj- es Gazipari Troszt, Hungary). *Energia es Atomtechnika,* vol. 30, Feb. 1977, p. 82-86. 7 refs. In Hungarian.

Increased use of hydrocarbons on a world scale, and in Hungary specifically (petroleum and natural gas imported from the USSR), to meet rising energy needs, accompanied by a decrease in the combustion of solid fossil fuels, is noted. Emission and immissions (specific pollution of a unit volume) are defined, major pollutants are identified (CO2, CO, hydrocarbons, SO2, NOx) and characterized briefly, and specific pollution forms (heat, soot, fly ash) are described. Emission levels worldwide for some pollutants are tabulated, along with proportions of major energy sources in use over the XX century (to 2000). Hungarian air pollution control measures and accepted levels are presented, and advantages of the use of stable fuel systems and natural gas are argued. R.D.V.

A77-31850 # **Critical comments concerning the application of the availability concept in power plant technology (Kritische Bemerkungen zur Anwendung des Verfügbarkeitsbegriffs in der Kraftwerkstechnik).** W. Brune (VEB Kernkraftwerk, Rheinsberg, East Germany). *Energietechnik,* vol. 27, Feb. 1977, p. 71-75. 17 refs. In German.

It is pointed out that there is as yet no generally recognized uniform exact definition for the important reliability criterion 'availability' in power plant technology. Existing availability definitions are examined and a proposal for improved empirical definitions is discussed. The derivation of stochastic availabilities on the basis of alternating renovation processes is also considered. The relation between the theoretically derived definitions and the proposed empirical definitions is investigated. G.R.

A77-31855 # **Energy-turn-rate characteristics and turn performance of an aircraft.** K. S. Yajnik (National Aeronautical Laboratory, Bangalore, India). *Journal of Aircraft,* vol. 14, May 1977, p. 428-433.

Specific energy of turn (SET), which is defined as the energy required to overcome drag per unit mass per turn, is a simple concept for evaluating the turn effectiveness of an aircraft. The characteristics of SET vs. turn rate indicate the effects of drag polar and wing loading under given conditions of flight. The simplicity of constant thrust/weight curves and constant maximum-lift-coefficient curves in the SET-turn-rate plane permits a convenient separation of their effects on the achievable peak sustained and transient turn-rates. SET is shown to be an absolute minimum at a certain optimum turn rate for the given configuration, wing loading, and flight conditions. The optimum turn rate is generally larger than that needed for maximum 4D ratio. Analytical expressions of optimum turn rate, minimum SET, and an index of flatness of the SET-turn-rate curve are obtained on the basis of a recent representation of the drag polar, which seems to be an acceptable approximation over a large range of angles of attack. An example is given to indicate possible applications to parametric studies. (Author)

A77-31889 **Particle size distributions of dusts in the flue gas of power plants and in atmospheric air (Korngrössenverteilungen von Stäuben im Rauchgas von Kraftwerken und in atmosphärischer Luft).** L. Laskus and E. Lahmann (Bundesgesundheitsamt, Institut für Wasser- Boden- und Lufthygiene, Berlin, West Germany). *Staub - Reinhaltung der Luft,* vol. 37, Apr. 1977, p. 136-140. 10 refs. In German.

A description is presented of investigations concerning the total dust concentration in the flue gas of coal-fired power plants, the concentration of a number of metallic elements, and the particle size distribution of the dust components. The results obtained for the flue gas investigations are compared with data of similar studies conducted with atmospheric dust. The metallic components considered include Ca, Fe, Cu, Zn, Mn, and Pb. G.R.

A77-31899 **Use of a Lowry-type spatial allocation model in an urban transportation energy study.** J. L. Edwards (Minnesota, University, Minneapolis, Minn.). *Transportation Research,* vol. 11, Apr. 1977, p. 117-126. 19 refs.

This paper describes the structure of a Lowry-type spatial allocation model and the results of using the model to evaluate several different hypothetical urban forms with respect to the level of transportation energy consumed in urban passenger travel. The Lowry-type model was used together with simple models of trip generation, mode choice and trip assignment to produce realistic land-use patterns and characteristic travel behavior in each city. Interzonal trip matrices were computed for each of five trip purposes (work, two types of shopping or service, non-home based and social) and, following the assignment of trips to the network, energy models for automobile as well as transit were utilized to assess the transportation energy consumed over all trip purposes in each of several different urban spatial structures. (Author)

A77-31935 # **Ways of improving fuel utilization in industry (Shliakhi pidvishchennia efektivnosti vikoristannia paliva v promislovosti).** V. F. Kopitov. *Akademiia Nauk Ukrains'koi RSR, Visnik,* vol. 41, Jan. 1977, p. 49-55. 5 refs. In Ukrainian.

Winning, primary processing, secondary processing, hauling, distribution, and conservation of fuel and fuel resources are surveyed, and the worldwide energy structure is examined. Efficiencies in extraction and utilization of fuels and utilization of energy are defined for various stages of fuel consumption. Ways of saving fuel, reduction of losses in burning fuel of low heating value, automation of gas combustion, choice of electric power or gas for industrial processes, heat insulation, and modification of industrial processes to minimize fuel and energy wastage are discussed. Measures of fuel conversion efficiency and fuel consumption efficiency are provided for various types of users and branches of industry. R.D.V.

A77-31951 **Selective black absorbers using RF-sputtered Cr2O3/Cr cermet films.** J. C. C. Fan and S. A. Spura (MIT, Lexington, Mass.). *Applied Physics Letters,* vol. 30, May 15, 1977, p. 511-513. 7 refs. USAF-sponsored research.

Excellent selective black absorbers for solar radiation, with solar absorptivity of over 0.9 and infrared emissivity of less than 0.1, have been obtained by using RF sputtering to coat metal substrates with a Cr2O3/Cr cermet film, then with a Cr2O3 antireflection coating. By determining the optical constants of Cr2O3/Cr films over the composition range up to 35 vol% Cr, it was found that films containing 29 vol% Cr are nearly optimum for this application. The optical and chemical properties of absorbers made with such films are quite similar to those obtained with electroplated Cr-black coatings. This similarity suggests that the electroplated coatings are actually Cr2O3/Cr cermets comparable in composition and microstructure to the sputtered films. (Author)

A77-32053 * # **Mass driver retrievals of earth-approaching asteroids.** B. O'Leary (Princeton University, Princeton, N.J.). *American Institute of Aeronautics and Astronautics and Princeton University, Conference on Space Manufacturing Facilities, 3rd, Princeton, N.J., May 9-12, 1977, AIAA Paper 77-528.* 10 p. 36 refs. Grant No. NsG-2062.

Mass driver tugs can be designed to move Apollo and Amor asteroids at opportunities of low velocity increment to the vicinity of the earth. The cost of transferring asteroids through a velocity interval of 3 km/sec by mass driver is about 16 cents per kilogram amortized over 10 years, about ten times less than that required to retrieve lunar resources during the early phases of a program of space manufacturing. About 22 per cent of a 200-meter diameter asteroid could be transferred to high earth orbit by an automated 100 megawatt solar-powered mass driver in a period of five years for a cost of approximately $1 billion. Estimates of the total investment of a space manufacturing program could be reduced twofold by using asteroidal instead of lunar resources; such a program could begin several years sooner with minimal concurrent development if asteroidal search programs and mass driver development are immediately accelerated. (Author)

A77-32054 * # **Space solar power - The transportation challenge.** H. P. Davis (NASA, Johnson Space Center, Future Programs Office, Houston, Tex.). *American Institute of Aeronautics and Astronautics and Princeton University, Conference on Space Manufacturing Facilities, 3rd, Princeton, N.J., May 9-12, 1977, AIAA Paper 77-529.* 8 p. 30 refs.

The status of space transportation systems analyses referable to the SPS (solar power satellite) is reviewed briefly. Propulsion systems (including magnetoplasmadynamic) and booster arrangements for the SPS mission and variants in recovery arrangements (including winged recovery) are summarized, along with proposals for production of SPS components in space from lunar and asteroidal materials. Transportation of the pilot plant into low circumterrestrial orbit or high geosynchronous orbit, transfers between those orbits, and construction of a large work bench structure (orbital construction demonstration article - OCDA) in low earth orbit are discussed.

R.D.V.

A77-32062 # **Environmental impact of space manufacturing.** R. R. Vondrak (Stanford Research Institute, Menlo Park, Calif.). *American Institute of Aeronautics and Astronautics and Princeton University, Conference on Space Manufacturing Facilities, 3rd, Princeton, N.J.; May 9-12, 1977, AIAA Paper 77-539.* 5 p. 15 refs.

The natural environments of the earth, the moon, and cislunar space can be affected by the construction and operation of large manufacturing facilities in space. Environmental impact occurs when gases, dust, and electromagnetic radiation are introduced into those regions in quantities exceeding that occurring naturally. In addition, various components of the natural environment in space and on the moon (e.g., gases, dust, electric fields, and magnetic fields) will influence the construction and operation of space manufacturing facilities. Potential environmental interactions are identified and some of the consequences are evaluated. (Author)

A77-32063 # **Microwave energy transmission.** W. C. Brown (Raytheon Co., Waltham, Mass.). *American Institute of Aeronautics and Astronautics and Princeton University, Conference on Space Manufacturing Facilities, 3rd, Princeton, N.J., May 9-12, 1977, AIAA Paper 77-540.* 9 p. 16 refs.

The basic features and characteristics of free-space power transmission by microwave beam and how they relate to applications in aerospace are reviewed. Special attention is given to how the technology can be better comprehended and confidence developed in its application to the satellite solar power station (SSPS) by 'learning curves' that are generated by sending increasing amounts of power over increasing distances by microwaves and which may have highly-visible and instructive intermediate benefits. The 'learning curves' are based upon an earth-based transmitter which is first used to supply power to an airborne vehicle, then enlarged to perform experiments upon the ionosphere, and enlarged again to transmit large amounts of power at useful power densities to synchronous orbit. (Author)

A77-32065 # **Fabrication and assembly of large composite structures in space.** F. F. W. Krohn and D. L. Browning (General Dynamics Corp., Convair Div., San Diego, Calif.). *American Institute of Aeronautics and Astronautics and Princeton University, Conference on Space Manufacturing Facilities, 3rd, Princeton, N.J., May 9-12, 1977, AIAA Paper 77-543.* 9 p.

Future space programs will require structural systems two to three orders of magnitude larger than present systems. A method is presented for on-orbit fabrication of space structures from continuous graphite/thermoplastic composite strip. The material is preconsolidated in the desired lamination orientation/thickness and compactly stored on reels for boost. On-orbit it is heated, formed into useful structural cross sections, and cooled, in a continuous process called 'rolltrusion'. This process is integrated with element assembly/joining operations in a beam fabricator capable of building up to 28 kilometers of uninterrupted beam from Shuttle-compatible material reels. A conceptual approach to construction of a photovoltaic solar-power satellite is also presented, and the status of current technology development is reviewed. (Author)

A77-32069 # **Assessment of satellite power stations.** R. A. Summers, H. R. Blieden (ERDA, Washington, D.C.), and C. E. Bloomquist (Planning Research Corp., Los Angeles, Calif.). *American Institute of Aeronautics and Astronautics and Princeton University, Conference on Space Manufacturing Facilities, 3rd, Princeton, N.J., May 9-12, 1977, AIAA Paper 77-552.* 9 p.

The paper reviews the satellite power station (SPS) concept. Most terrestrial solar electric power generation systems, unless provided with large storage capability, lack baseload capability which is essentially the ability to provide continuous operation. SPS, however, offers the possibility of significant solar-powered baseload without major meteorological, geographical, or diurnal constraints, or significant storage requirements. A SPS in geostationary orbit would convert solar energy to microwave energy for transmission to earth where it is transformed into electricity. The seven major components of a photovoltaic satellite power station are: geostationary orbit, photovoltaic conversion, microwave transmission to ground station (rectenna), utility interface, transportation system (launch vehicle, tug), ground complex, and orbital facilities (manned). As part of an analysis of the current status of the SPS, systems definition and space related technology are described; health, safety, and environmental impacts considered; and socio-economic implications discussed. M.L.

A77-32086 # **Influence of the intended use of an aircraft on the optimal parameters of gas-turbine power plants (Vliianie tselevogo naznacheniia letatel'nykh apparatov na optimal'nye parametry silovykh ustanovok s GTD).** V. G. Maslov, S. K. Bochkarev, and V. S. Kuzmichev. *Aviatsionnaia Tekhnika,* vol. 19, no. 4, 1976, p. 68-74. 6 refs. In Russian.

The dependence of accepted criteria for evaluating the engine/aircraft system on the gas-turbine engine parameters is examined. Equations relating the weight, cost-effectiveness, and air technical criteria to the specific weight and specific fuel consumption of gas-turbine engines are derived, along with equations interrelating the optimal engine parameters for various evaluation criteria and various flight ranges. V.P.

A77-32116 # **Theory of the Schottky barrier solar cell.** P. T. Landsberg and C. Klimpke (Southampton, University, Southampton, England). *Royal Society (London), Proceedings, Series A,* vol. 354, no. 1676, Apr. 21, 1977, p. 101-118. 24 refs. Research supported by the Science Research Council and NATO.

A model of Schottky barrier solar cells with an interfacial layer is described which takes into account more accurately than has been done so far the dependence of barrier height on the interfacial density of states (Ds) and consequently the various potential drops in the cell. This improvement tends to yield higher predicted efficiencies for low values of Ds. Also taken into account is the recombination traffic through the interfacial states. This effect is important at high values of Ds when it lowers the predicted efficiency. Recombination in the transition and bulk regions is also considered, but this does not have a very marked effect. Numerical results are given for a Au-SiO2-Si contact. A new effect - the possible fanning out of the quasi-Fermi levels for the interfacial states - is also noted. (Author)

A77-32169 **Considerations on coal gasification (Einige Überlegungen zur Kohlevergasung).** J. E. Franzen (Krupp-Koppers GmbH, Essen, West Germany). *Technische Mitteilungen Krupp, Forschungsberichte,* vol. 35, Jan. 1977, p. 83-94. 16 refs. In German.

Commercial processes for gasification of coal with oxygen are discussed. The Koppers-Totzek process of gasification of coal dust gasification, in which fine dust-like fuel particles are carried through the gasification chamber in the flow of the gasification medium, is described. The outlook for future application of coal gasification is discussed. P.T.H.

A77-32208 High level concentration of sunlight on silicon solar cells. L. S. Napoli, G. A. Swartz, S. G. Liu, N. Klein, D. Fairbanks, and D. Tamutus (RCA Laboratories, Princeton, N.J.). *RCA Review,* vol. 38, Mar. 1977, p. 76-108. 8 refs. ERDA Contract No. 02-7996.

Silicon solar cells have achieved 15.5% conversion efficiency at 330 suns concentration level. Design rules regarding the fabrication and use of these solar cells at high concentration levels are derived. Finally, a system consisting of lens arrays and solar cells designed to generate 100 watts is described in detail. Preliminary data shows that the system efficiency is 8.3% during conditions of 74 mW/sq cm insolation level. (Author)

A77-32209 Industry can save energy without stunting its growth. T. Alexander. *Fortune,* vol. 95, May 1977, p. 186-189 (4 ff.).

Co-generation of electric power and other forms of energy needed in industry by the same power package, coalescence of 'energy centers,' efficiency concepts based on the 2nd law of thermodynamics and not just the 1st law, and other approaches to saving energy in industry at both the energy-production stage and the energy-use stage are surveyed in a broad study of ways to approach an energy-efficient society. Energy demand could be leveled off by the turn of the century, with zero energy growth combined with expansion of capital in energy-efficient equipment and processes, and industry generating (or reusing more efficiently) an appreciable fraction of its own energy needs. Examples of equipment and process redesign, elimination of heat/cool and wet/dry cycles, simple housekeeping measures, and cascading processes paying serious attention to the 2nd law of thermodynamics are described. R.D.V.

A77-32211 Hydrodynamic basis of wave-energy converters of channel form. M. J. French (Lancaster University, Lancaster, England). *Journal of Mechanical Engineering Science,* vol. 19, Apr. 1977, p. 90-92.

The paper analyzes a problem of energy extraction from sea waves in which the vertical plane containing the motion is perpendicular to the wave direction and the surfaces are in facing pairs defining channels down which the waves travel, being attenuated as they go. The analysis concerns an ideal case in which the absorbing walls are of unlimited depth, whereas in the practical device they must be relatively shallow; the wall is the skin of a series of partially inflated air bags, formed by dividing a long tube by transverse septa. The very simple intuitive treatment in which the wave train is considered simply to be attenuated exponentially gives results which in practical cases are very good approximations. A numerical example is provided, and defects pertinent to the analysis are identified. S.D.

A77-32215 Solar sails (La voile solaire). A. Brahic. *La Recherche,* vol. 8, May 1977, p. 463-466. In French.

Plans for an aluminum-coated plastic sail displaced by solar radiation pressure (NASA-funded study) and the history of solar-sail concepts (Tsiolkovskii 1921) are recounted. Suitable sail materials (polyamides or polyesters with aluminum coat) and technological problems (stowage and folding, deployment and imparting rigidity in deployed mode, materials selection, piloting and maneuvering) are discussed. A space vehicle guided by solar sail would be maneuverable with no fuel requirement, even at great distances from the sun. Balancing solar radiation pressure against local gravitational fields is discussed. Use of such a vehicle as ferry in trips to Mercury, Jupiter, Saturn, or escaping from the solar system, and practicable payloads in ferry missions, are taken up. R.D.V.

A77-32220 # Role of the nuclear energy system in the total fuel-energy picture in the USSR (Rol' iadernoenergeticheskoi sistemy v toplivo-energeticheskom komplekse SSSR). N. A. Dollezhal' and L. A. Melent'ev. *Akademiia Nauk SSSR, Vestnik,* no. 1, 1977, p. 87-99. In Russian.

The increasing importance of developing new nuclear power stations in the Soviet Union is discussed. The different geographical regions of the country are examined with respect to their need for nuclear energy and with respect to projected capital expenditures. P.T.H.

A77-32243 * # Synchronization of the ERDA-NASA 100 kW wind turbine generator with large utility networks. H. H. Hwang (Hawaii, University, Honolulu, Hawaii) and L. J. Gilbert (NASA, Lewis Research Center, Cleveland, Ohio). *Institute of Electrical and Electronics Engineers, Control of Power Systems Conference and Exposition, College Station, Tex., Mar. 14-16, 1977, Paper.* 16 p. 5 refs. Research supported by the Hawaiian Natural Energy Institute and NASA.

The synchronizing of a wind turbine generator against an infinite bus under random conditions is studied for the first time. With a digital computer, complete solutions for rotor speed, generator power angle, electromagnetic torque, wind turbine torque, wind turbine blade pitch angle, and armature current are obtained and presented by graphs. Experiments have been recently performed on the ERDA-NASA 100 kW wind turbine. Experimental results matched computer study results very closely and confirmed that the synchronization can be accomplished by means of the existing speed control system and an automatic synchronizer. (Author)

A77-32244 Use of Landsat data for the detection of marine oil slicks. M. Deutsch (U.S. Geological Survey, Reston, Va.), A. E. Strong (NOAA, Rockville, Md.), and J. E. Estes (California, University, Santa Barbara, Calif.). *American Institute of Mining, Metallurgical and Petroleum Engineers, Offshore Technology Conference, Houston, Tex., May 2-5, 1977, Paper.* 8 p. 8 refs.

The capability of Landsat to detect some oil slicks in marine waters has been verified. Reflectance anomalies associated with the slicks have been detected visually on film data, by photo-optical enhancement techniques and by computer processing. Applications of Landsat oil slick data include environmental monitoring of coastal waters and detection of natural seeps such as in the Santa Barbara Channel, which may serve as a worldwide exploration aid. (Author)

A77-32247 Petrochemical basic products from coal - Production of basic and intermediate products for the chemical industry according to the Fischer-Tropsch process (Petrochemische Grundprodukte aus Kohle - Erzeugung von Grund- und Zwischenprodukten für die chemische Industrie nach den Fischer-Tropsch-Verfahren). R. Kühn and M. Elstner (Union Rheinische Braunkohlenkraftstoff AG, Wesseling, West Germany). *Erdöl und Kohle Erdgas Petrochemie Vereinigt mit Brennstoff-Chemie,* vol. 30, Mar. 1977, p. 117-122. In German.

A summary is presented of the most important results which were obtained in a government-sponsored study conducted in West Germany concerning the possibilities for an economical production of basic and intermediate petrochemical products on the basis of Fischer-Tropsch syntheses utilizing domestic coal. The study was concluded in June 1976. A Fischer-Tropsch synthesis, as considered in the study, is a catalytic carbon monoxide hydration which provides as products, in addition to mixtures of paraffins and olefins, also oxygen-containing compounds. The syntheses considered in-

clude processes in the gaseous and the liquid phase. Attention is given to the processing of the primary products, the primary products obtained in 12 selected processes, and questions related to the economics of the selected processes. It is concluded that on the basis of the costs and the present value of the obtained products the use of the Fischer-Tropsch synthesis is currently not economical in Europe. Factors which can lead to changes in this situation are examined. G.R.

A77-32248 Molecular synthesis in the case of the Fischer-Tropsch synthesis - Reaction steps of the molecular synthesis by means of the catalytic transformation of carbon monoxide and hydrogen (Molekülaufbau bei der FT-Synthese - Reaktionsschritte des Molekülaufbaus durch katalytische Umsetzung von Kohlenoxid und Wasserstoff). H. Schulz (Karlsruhe, Universität, Karlsruhe, West Germany). *Erdöl und Kohle Erdgas Petrochemie Vereinigt mit Brennstoff-Chemie,* vol. 30, Mar. 1977, p. 123-131. 31 refs. In German.

The pressure-temperature operational ranges of the synthesis catalysts are considered along with aspects concerning the selectivity of the transformations, questions of process thermodynamics, the formation of CH2-chains, the transfer of hydrogen, and desorption and hydrogen solution reaction steps. Attention is given to chain length, the synthesis products, the formation of branched molecular structures, olefins, oxygen compounds, and the formation of acids, esters, and ketones. G.R.

A77-32249 Synthesis of substitute natural gas on the basis of coal (Synthese von Erdgas-Austauschgas auf Basis Kohle). H. Hammer (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). *Erdöl und Kohle Erdgas Petrochemie Vereinigt mit Brennstoff-Chemie,* vol. 30, Mar. 1977, p. 132-136. 21 refs. In German.

The present state of development of processes for producing substitute natural gas (SNG) based on coal or lignite is discussed. The historical and theoretical (thermodynamics, kinetics and reaction mechanism) background of the direct hydrogenating gasification of coal as well as that of heterogeneous catalytic methanation of carbon monoxide is reviewed. Processes currently being developed specially in the U.S., UK and West Germany are examined. Since the high production costs for SNG presently amounts to about 2 to 3 times the price for natural gas, one hesitates to take up the production of SNG in spite of the shortage of natural gas in the United States. (Author)

A77-32251 # Future propulsion plants. I (Triebwerke der Zukunft. I). W. Heilmann (Motoren- und Turbinen-Union München GmbH, Munich, West Germany). *Flug Revue/Flugwelt International,* May 1977, p. 46, 49-51. In German.

New technologies and improvements in existing technologies for the power plants of winged aircraft, and RPV are surveyed. Requirements for propulsion plants (lower fuel consumption, higher specific thrust, lower weight), special requirements for RPV propulsion (lower unit price, compactness), special requirements for military vehicles (reliability, broad flight envelope, dash power), and requirements for civilian aircraft propulsion (low noise, long life, low emissions) and rotorcraft systems (high acceleration, low price, emergency power) are outlined. EB welding and friction welding technology, compressor design, turbine blade cooling, and handling of hot-gas streams are discussed. R.D.V.

A77-32313 # Investigation of a coaxial explosion-type MHD generator (Issledovanie koaksial'nogo MGD-generatora vzryvnogo tipa). Iu. A. Burenin and G. A. Shvetsov (Akademiia Nauk SSSR, Institut Gidrodinamiki, Novosibirsk, USSR). *Fizika Goreniia i Vzryva,* vol. 13, Jan.-Feb. 1977, p. 130-132. In Russian.

The paper presents a numerical investigation of the energetic characteristics of the three modes of operation of a coaxial explosion-type MHD generator. Ranges of initial parameters are determined for obtaining conversion efficiencies of energy of a moving piston to electromagnetic energy, close to one. B.J.

A77-32375 # Thermally induced migration of hydrocarbon oil. A. A. Fote, R. A. Slade, and S. Feuerstein (Aerospace Corp., El Segundo, Calif.). *ASME, Transactions, Series F - Journal of Lubrication Technology,* vol. 99, Apr. 1977, p. 158-162. 9 refs. Contract No. F04701-75-C-0076.

An investigation of the surface migration of thin films of hydrocarbon oil on metal substrates has been undertaken to determine the effect of temperature gradients on the distribution of lubricants in spacecraft mechanical assemblies. The results of experiments performed in air were discussed earlier. We now discuss the results of experiments performed under vacuum. The important role played by surface finishes is demonstrated. Mathematical models of these results are developed. (Author)

A77-32401 Cooling with solar energy (Kühlen mit Sonnenenergie). K. Schubert and J. Dreyer. *Dornier-Post,* no. 1, 1977, p. 9-11. In German.

Advantages of an absorption cooling system based on the use of solar energy are partly related to the fact that no long-term storage facilities are needed because the amount of solar energy supplied on a temporal basis corresponds approximately to the energy required for cooling. Other advantages are connected with decentralized application possibilities, the employment of reliable technologies, and high operational efficiency. System components and operational processes are considered and a description is given of a demonstration project involving the construction of a cooling installation, based on solar energy, by West German companies. G.R.

A77-32402 Novel development for economic solar-energy utilization (Neuartige Entwicklung für wirtschaftliche Solarenergie-Nutzung). W. Scherber. *Dornier-Post,* no. 1, 1977, p. 12-14. In German.

Thermal losses related to the radiation emitted by the surfaces of solar energy collectors can be avoided with the aid of selectively absorbing surfaces. The considered surfaces have excellent absorption characteristics for solar radiation and emit very little thermal radiation. The selective absorption properties are obtained with the aid of special surface layers. The advantages of selective absorbers for applications in the low-temperature range up to 150 C and for the generation of heat at temperatures in the range from 300 to 500 C are discussed. Attention is also given to the physical principles of operation and problems concerning the practical implementation of the involved principles. G.R.

A77-32403 A solar generator (Solargenerator). J. Dreyer and H. Gehrke. *Dornier-Post,* no. 1, 1977, p. 15, 16. In German.

A short-term and intermediate-term solution concerning the decentralized supply of the population in developing countries with electric power can be provided by an approach based on the utilization of regenerative energy sources such as wind or solar energy. A description is presented of a project of West German companies related to the development of a 10-kW solar generator which utilizes for the operation of a turbine, low-temperature heat in the range from 90 to 140 C obtained directly from a solar energy collector or from a thermal storage tank. G.R.

A77-32404 **Hydrogen production with HOT ELLY (Wasserstofferzeugung mit HOT ELLY).** W. Dönitz. *Dornier-Post,* no. 1, 1977, p. 17-19. In German.

A West German company develops currently the basic design principles for a new energetically advantageous process for the decomposition of water with the aid of a high-temperature gaseous phase electrolysis (HOT ELLY). The theoretical efficiency of the considered process for hydrogen production is as high as 50%. A solid electrolyte consisting of stabilized ZrO2 ceramic materials is used. An electrolysis at about 1000 C with or without high-temperature reactors is considered. G.R.

A77-32432 **Electric power fluctuations in a MHD generator.** M. L. Mittal and G. H. Masapati (Indian Institute of Technology, Bombay, India). *Letters in Applied and Engineering Sciences,* vol. 5, Apr. 1977, p. 141-153. 7 refs. Research sponsored by the Council of Scientific and Industrial Research of India.

In this analysis, the fluctuations produced in the electric power output of a MHD generator due to the Hall and the ion slip currents and pressure disturbances have been investigated. The problem has been solved analytically. It is found that the Hall and the ions slip currents produce fluctuations during the transient time, the pressure disturbances produce permanent fluctuations. The variation of power output for various parameters has been computed and shown graphically. (Author)

A77-32440 **Space: A resource for earth - An AIAA review.** Edited by J. Grey (American Institute of Aeronautics and Astronautics, Inc., New York, N.Y.), P. Downey (Boeing Aerospace Co., Seattle, Wash.), and B. Davis (Battelle Columbus Laboratories, Columbus, Ohio). New York, American Institute of Aeronautics and Astronautics, Inc., 1977. 73 p. $8.50.

The present review identifies and documents the many applications of space systems that have improved the quality of human life on earth. It provides a sourcebook of information on the technical elements, histories, uses, and impacts of communication satellite systems, navigation satellite systems, land-observation systems, satellites designed for sea and maritime observations, meteorological and other atmospheric-observation satellites, as well as on the future potential of space processing, life-science programs in space, and space-based solar power. Specific satellites and space systems discussed include Echo I, Syncom, ATS, Intelsat/Comsat, the Defense Satellite Communication Systems, Aerosat, Marisat, Transit I, the Navstar/GPS system, the Defense Meteorological Satellite Program, Skylab, the Landsat system, GEOS-3, Seasat, Tiros, Nimbus, ITOS, SMS, GOES, the space shuttle, and Spacelab. Detailed attention is given to the utilization and benefits of each system, Landsat results, meteorological observations, various space-processing experiments, and proposed designs for space-based solar power plants. F.G.M.

A77-32470 **Solar electric power generating stations in space - XXI century energy or a utopia (Les centrales électriques solaires dans l'espace - Energie du XXIe siècle ou utopie).** M. Claverie. *L'Aéronautique et l'Astronautique,* no. 63, 1977, p. 3-14. 8 refs. In French.

The history and present status of projections on building solar power stations on the earth's surface and in orbit (with transmission of power by microwaves to earth) are surveyed. Storage and energy conversion, arrangements with a central collector or with distributed collectors, the outlook for cutting solar photovoltaic cell costs, and available solar energy for collection are discussed, and the photovoltaic approach and direct thermal conversion approach are compared. Parameters and limitations of an in-orbit station and a ground-level station (mid-Mediterranean) are compared. Attention is drawn to the major unknowns of an in-orbit solar power station: antenna array performance, incoherence of a very large wavefront, in-orbit construction, ecological effects, biological effects, EM interference. R.D.V.

A77-32506 # **Thermodynamic analysis of the formation of the oxides of nitrogen and sulfur in fuel combustion products (Termodinamicheskii analiz obrazovaniia okislov azota i sery v produktakh sgoraniia topliv).** E. V. Samuilov, I. B. Rozhdestvenskii, N. N. Tsitelauri, V. N. Gutov, and K. K. Olevinskii (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). *Teplofizika Vysokikh Temperatur,* vol. 15, Jan.-Feb. 1977, p. 35-41. 11 refs. In Russian.

The paper presents results of the calculation of the equilibrium concentrations of the oxides of nitrogen and sulfur in the combustion products of different fuels: coals, petroleum residues, and fuel gases. The influence of different oxidizers - air, enriched air, and oxygen - on the oxide content is studied, and it is shown that this content is strongly dependent on oxidizer content, temperature, pressure, and type of fuel. B.J.

A77-32518 # **Cathode spots on metallic electrodes of an MHD-channel (Katodnye piatna na metallicheskikh elektrodakh v ustoviiakh kanala MGD-generatora).** I. I. Beilis, V. I. Zalkind, and A. S. Tikhotskii (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplofizika Vysokikh Temperatur,* vol. 15, Jan.-Feb. 1977, p. 158-163. 16 refs. In Russian.

Arc-discharge processes at MHD-channel electrodes are analyzed on the basis of experimental data. A theoretical description of such discharges is obtained, according to which spots burn by evaporation of a previously deposited impurity film, while the spot temperature is defined by the cathode's heat conductivity. V.P.

A77-32519 # **Experimental study of accelerating MHD-generator jets with supersonic flow distortion (Eksperimental'noe issledovanie razgonnykh sopel MGD-generatorov s deformatsiei sverkhzvukovogo potoka).** N. M. Efremov, B. A. Tikhonov, and V. A. Khalkevich (Akademiia Nauk SSSR, Institut Atomnoi Energii, Moscow, USSR). *Teplofizika Vysokikh Temperatur,* vol. 15, Jan.-Feb. 1977, p. 164-167. In Russian.

A77-32520 # **Influence of flow nonuniformity on plasma instability at the channel wall (Vliianie neodnorodnosti techeniia na neustoichivost' plazmy vblizi stenki kanala).** V. P. Meitlis (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplofizika Vysokikh Temperatur,* vol. 15, Jan.-Feb. 1977, p. 168-171. 5 refs. In Russian.

The stability of plasma flows along electrodeless MHD-channel walls is analyzed. The influence of nonuniform plasma motion on the development of oscillations is examined. The conditions for the onset of several types of instability are formulated. V.P.

A77-32521 # **Processing of experimental data with the U-25 facility with the aid of a data measuring system (Obrabotka rezul'tatov eksperimentov na ustanovke U-25 s pomoshch'iu informatsionno-izmeritel'noi sistemy).** A. D. Iserov, V. I. Kalinin, L. L. Kirsanov, V. E. Lukash, G. P. Maliuzhonok, E. I. Novikov, A. V. Orlov, L. P. Poberezhskii, and V. Ia. Shemiakin (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplofizika Vysokikh Temperatur,* vol. 15, Jan.-Feb. 1977, p. 179-185. 7 refs. In Russian.

Some aspects of the application of a data measuring system to the planning of experiments, using the power-generating MHD facility, U-25, are examined. Some problems involved in the processing of data obtained with this system are discussed. V.P.

A77-32591 **Production of electricity through thermodynamic conversion of solar energy - 10 MWe project.** J.-L. Abatut (CNRS, Laboratoire d'Automatique et d'Analyse des Systèmes, Toulouse, France). *Revue de l'Energie,* vol. 28, Apr. 1977, p. 230-238. In English and French.

The design of a French solar energy plant planned for construction in 1982 is described. A large number of 7m x 7m heliostats (motor-driven mirrors) will be arranged on the ground so as to concentrate and reflect the sun's image. A boiler, placed on top of a 100 to 200-meter high tower, will receive the solar flux concentrated by the bank of heliostats. Parameters for optimizing tower design are discussed. The heliostats' reflecting material, support structure, drive mechanism, and servos for alignment are described. A prototype is scheduled to be put into service in 1980. M.L.

A77-32592 **Energy from bio-conversion for developing countries.** J. K. Parikh (International Institute for Applied Systems Analysis, Laxenburg, Austria). *Revue de l'Energie,* vol. 28, Apr. 1977, p. 239-251. 14 refs. In English and French.

Large- and small-scale organic waste anaerobic fermentation systems used in developing countries are described. These systems generate a gas which is 60% methane. The leftover sludge, which retains nitrogen compounds, is used as fertilizer. A bio-gas plant used in India has two main parts, a digester and a gas holder. Data concerning the amount of dung consumed and the amount and the quality of gas produced are provided. Characteristics of Indian communities are described and the economic impact of single-family bio-gas plants is analyzed. M.L.

A77-32593 **Thermochemical production of hydrogen Myth or reality.** G. Donat, B. Esteve, and J.-P. Roncato (Gaz de France, Direction des Etudes et Techniques Nouvelles, Paris, France). *Revue de l'Energie,* vol. 28, Apr. 1977, p. 252-268. 9 refs. In English and French.

A computer approach to discovering economically attractive thermochemical cycles for producing hydrogen from water is described. A thermochemical system would do away with prior production of electricity (required by electrolytic processes for generating hydrogen) by making direct use of heat through a series of chemical reactions which consume only water on an overall basis, since all compounds other than hydrogen and oxygen are reformed by the time the cycle repeats itself. A thermochemical cycle is similar to a heat engine which produces a certain amount of potential work in the form of oxygen and hydrogen. The computer search used the variation of the free enthalpy function G rather than the enthalpy function H and analyzes irreversible processes. No thermochemical cycle competitive with electrolytic techniques was discovered. Although hybrid cycles which involve the use of some external electricity have not been fully analyzed, French future research will focus on electrolytic techniques for generating hydrogen. M.L.

A77-32597 # **Vapor-phase fabrication of massive structures in space.** H. K. Henson (Analog Precision, Inc., Tucson, Ariz.) and K. E. Drexler (MIT, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics and Princeton University, Conference on Space Manufacturing Facilities, 3rd, Princeton, N.J., May 9-12, 1977, AIAA Paper 77-542.* 7 p. 18 refs.

Vapor deposition may be an economical approach to processing and fabricating metals (especially aluminum) in space. This method, which uses to advantage the sunlight, vacuum, and zero gravity conditions of space, is found to have advantages when considered from metallurgical, physical and cost viewpoints. A design for a large scale (250 ton) solar powered deposition apparatus with a throughput rate of 10 kg/second and the associated physical and chemical material problems are described in detail. Strength and fracture mechanics considerations may favor silica fiber reinforcement of seamless aluminum pressure vessels vapor deposited on inflated forms for space habitats. (Author)

A77-32601 **Inhibited ethylene glycol as the solar nexus.** E. Beynon (Union Carbide Tarrytown Technical Center, Tarrytown, N.Y.). *National Association of Corrosion Engineers, International Corrosion Forum Devoted Exclusively to the Protection and Performance of Materials, San Francisco, Calif., Mar. 14-18, 1977, Paper.* 9 p. 15 refs.

Well-inhibited ethylene glycol base fluids (ethylene glycol with anti-corrosion additives) are considered quite capable of protecting flat plate solar collector systems from corrosion. Current formulations are designed for multimetal systems, but as solar systems become more standardized, it is possible that the mix of inhibitor additives can be optimized for a given combination of metals. Factors accelerating corrosion in a solar energy system include the presence of galvanic couples, crevices, aeration, corrosion products, metal stresses, localized hot spots, high heat transfer fluid temperatures, poor quality water, and fluid flow rates which, if high, produce erosion-corrosion, and if low, can increase crevice attack because of differential cells. M.L.

A77-32602 **Corrosion prevention in aluminum solar systems.** J. M. Popplewell. *National Association of Corrosion Engineers, International Corrosion Forum Devoted Exclusively to the Protection and Performance of Materials, San Francisco, Calif., Mar. 14-18, 1977, Paper.* 18 p. 6 refs.

Corrosion problems with aluminum flat plate collectors in multimetal solar systems are examined. Corrosion of internal surfaces is discussed in terms of galvanic attack, pitting corrosion, erosion corrosion, crevice corrosion and other forms of corrosion. Attention is given to prevention of corrosion using a variety of approaches. These include 'gettering' of heavy metal ions and the use of nonaqueous heat transfer fluids. Guidelines to avoid aluminum corrosion are provided. S.D.

A77-32603 **Corrosion problems in solar energy systems.** P. D. Thompson and M. B. Hayden (U.S. Department of Agriculture, Genetics and Management Laboratory, Beltsville, Md.). *National Association of Corrosion Engineers, International Corrosion Forum Devoted Exclusively to the Protection and Performance of Materials, San Francisco, Calif., Mar. 14-18, 1977, Paper.* 6 p. 5 refs.

Solar heat collection is expected to gain wide recognition only if the operating life of a solar heating system can be long enough to repay the cost of the initial investment. Corrosion problems typical of solar heating systems are discussed. The most pressing problem in solar heating system design is control of corrosion in aluminum absorbers. Any extremes of pH, dissolved heavy metal or chloride ions in the water, 'hard' water, and dissolved oxygen increase the risk of corrosion in aluminum absorbers. Another problem is the difficulty of building single-metal systems. Plastic components such as fiber glass or CPVC pipe can be used to some extent but their procurement in a full range of sizes and configurations is difficult. General approaches to corrosion protection in solar heating systems are discussed, with special emphasis on water treatment as the best protective measure. Toxic corrosion inhibitors should be avoided since they must be discharged when the system is emptied. S.D.

A77-32604 **Oxidation-erosion of materials in high velocity hot gases.** J. A. Goebel, D. R. Spriggs, R. H. Barkalow, and F. S. Pettit (United Technologies Corp., Pratt and Whitney Aircraft Group, Middletown, Conn.). *National Association of Corrosion Engineers, International Corrosion Forum Devoted Exclusively to the Protection and Performance of Materials, San Francisco, Calif., Mar. 14-18, 1977, Paper.* 16 p. 9 refs. Research supported by the Electric Power Research Institute.

Results are presented regarding the interaction between erosion and oxidation of materials in a study program intended to characterize the behavior of state-of-the-art industrial turbine materials in a laboratory combustor test rig under carefully controlled conditions designed to simultaneously induce both erosion and corrosion effects at temperatures and gas velocities typical of gas turbines. Baseline oxidation behavior of the oxidation-erosion test materials was evaluated at 1600 F by testing in the ducted rig without ingestion of abrasive particles. A major conclusion is that the interaction between the oxidation and erosion process is taking place, the oxidation products being most effective in modifying substrate erosion at low angles of particulate impact. S.D.

A77-32608 Laboratory investigation of high temperature alloy failure mechanisms. L. H. Wolfe (Continental Oil Co., Ponca City, Okla.). *National Association of Corrosion Engineers, International Corrosion Forum Devoted Exclusively to the Protection and Performance of Materials, San Francisco, Calif., Mar. 14-18, 1977, Paper.* 13 p.

Failure analyses of high-temperature materials from ethylene plants reveal that high-temperature outlet systems of furnaces should have gradual changes of section size with welds removed from high-stress areas. In particular, silicon of about 2 wt% can greatly reduce the carburization rate of austenitic alloys in wet ethane but has considerably less effect in dry ethane. Metal dusting can take place fairly rapidly in a variety of alloys with a nonidentical mechanism. Aluminized surfaces on austenitic alloys can resist sulfur attack and oxidation but not at the very high temperatures available in coal gasifiers. Also discussed is high-temperature hydrogen permeation in stainless steels. S.D.

A77-32799 Energy in competition (Energie im Wettbewerb). *Energie,* vol. 29, Mar. 1977, p. 46-48. In German.

The relationship between expanding production, relief of unemployment, and expanded energy production and consumption is outlined, and effects of a continuing moratorium on building of nuclear power plants on the West German economy are assessed. Costs of coal-derived and nuclear-derived large-scale power are compared. An energy gap of some 13,000 MW is forecast for 1985, and 30,000 MW for 1990, as extrapolated from the current situation and current policies. Supplementary power from nuclear energy is argued for as indispensable. New modernized coal-fired plants are discussed as more efficient, more economical, and ecologically superior. R.D.V.

A77-32800 Operating experience with the combined unit of the III/A central heating power plant of the Duisburg AG municipal utility (Betriebserfahrungen mit dem Kombiblock des Heizkraftwerkes III/A der Stadtwerke Duisburg AG). W. Wein, L. Stauch, F.-W. Meier, and K.-H. Budzynski. *Energie,* vol. 29, Mar. 1977, p. 64-71. In German.

The performance of major components of the Duisburg AG central heating plant III/A is described. Data are provided on the gas turbine, 140 MW steam turbine, boiler plant, and waste-gas handling facilities. A flowsheet for heat circulation is provided. The performance of valves, piping, fasteners, packing, limit switches, steam generating unit, and overvoltage protection gear is discussed. Damage incurred in abrupt temperature changes, system outages, and oversensitivity of some transducers to heat are discussed. Performance of the Iskamatic B process control and interlocking system is described. R.D.V.

A77-32868 # Combined studies of the sun and isotope ecology (Kompleksnoe izuchenie solntsa i izotopnaia ekologiia). G. E. Kocharov (Akademiia Nauk SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR). *(Mezhdunarodnyi Seminar po Aktivnym Protsessam na Solntse i Probleme Solnechnykh Neitrino, 8th, Leningrad, USSR, Sept. 25-27, 1976.) Akademiia Nauk SSSR, Izvestiia, Seriia Fizicheskaia,* vol. 41, Feb. 1977, p. 415-421. 5 refs. In Russian.

The promise of isotope ecology is seen to be substantiated by the abundance of various isotopes, revealed by combined solar studies, in various parts of our environment, and by the fact that the isotopes provide information on solar activity. The present paper deals briefly with the following problems: the interrelationship between processes occurring in the interior and at the surface of the sun; the application of combined studies to the investigation of the various components of solar radiation; and methods of extracting information on solar activity from ambient isotopes. V.P.

A77-32954 Distribution of some hydrocarbons in ambient air near Delft and the influence on the formation of secondary air pollutants. R. Bos, R. Guicherit, and A. Hoogeveen. (Central Organization for Applied Scientific Research in the Netherlands, Research Institute for Environmental Hygiene TNO, Delft, Netherlands). *Science of the Total Environment,* vol. 7, May 1977, p. 269-281. 11 refs.

The relative concentrations of hydrocarbons in the atmosphere may provide information concerning their origin. It appears that the hydrocarbon composition measured in Delft (The Netherlands) is entirely different for northern and southern wind directions. This points to different sources. The most important sources for this area are natural gas leaks, traffic, and (petrochemical) industries. It appears that the relative potential of the precursor mix to form peroxyacetylnitrate (PAN) and ozone is also different for both wind directions. (Author)

A77-32973 # Fabrication of solar energy concentrators based on polyurethane foams using new polyol and isocyanate compounds (Izgotovlenie kontsentratorov solnechnoi energii na osnove penopoliuretanov s primeneniem novykh poliol'nykh i izotsianatnykh komponentov). B. A. Kalinin and B. A. Bazarov (Akademiia Nauk Turkmenskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). *Akademiia Nauk Turkmenskoi SSR, Izvestiia, Seriia Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk,* no. 6, 1976, p. 41-47. 12 refs. In Russian.

The paper considers the production of a new rigid polyurethane foam to be used as a construction material for solar concentrators. The foam is prepared from a complex polyether, dicarboxylic acid mixtures, and an isocyanate compound - diurethane diethylene glycol. B.J.

A77-33113 Solar technology: Solar energy in practical application /3rd revised and enlarged edition/ (Heliotechnik: Sonnenenergie in praktischer Anwendung /3rd revised and enlarged edition/). H. Rau. Munich, Udo Pfriemer Verlag GmbH, 1976. 239 p. 92 refs. In German. $15.60.

The book provides an overview of the vast range of applications to which solar energy has been put throughout the world. The solar programs of different countries are reviewed, and the basic design and operation of a number of actual engineering realizations are described, including solar stills for desalinization, room heating, sun houses, solar-driven air conditioning with heat pumps, solar cookers, solar melting ovens, solar cells and batteries, and solar motors. Future projects for solar technology are also discussed, including a central solar power station, solar mirror in earth orbit, exploitation of ocean thermal gradients, and magnetohydrodynamic generators driven by solar heat. P.T.H.

A77-33114 Wind energy in practical use: Wheels, rotors, mills, wind power plants (Windenergie in praktischer Nutzung: Räder, Rotoren, Mühlen, Windkraftiverke). F. von König. Munich, Udo Pfriemer Verlag GmbH, 1976. 182 p. 57 refs. In German. $15.60.

A descriptive survey of the use of wind power and equipment for harnessing wind energy. Slightly less than half the text deals with the history of wind-power equipment, windmills in particular, and covers equipment for wind measurements, anemographs, wind wheels, and prayer wheels. More recent developments are described; Savonius rotor and other rotors, farmstead wind turbines, aeolian motors, new wind motors for generating electric power, large-scale wind tower projects, and wind engine parks. A separate chapter is devoted to the wind as an energy vehicle, and another chapter to economical exploitation of wind power. The text is generously illustrated throughout. R.D.V.

A77-33124 **The impact of the new energy technologies.** G. L. Decker (Dow Chemical Co., Midland, Mich.). *Mechanical Engineering,* vol. 99, May 1977, p. 24-27. 6 refs.

Contributions of various forms of energy deemed commercially practicable by the end of the century are projected to meet an energy demand of 185 quads (quadrillions BTU). All contributing sources are charted for comparison, with the brunt borne by: clean burning of coal, improved nuclear technology, coal liquefaction, coal gasification, and savings through some modes of conservation. Fusion and hydrogen technologies do not figure, being judged not commercially practicable by the turn of the century. Little contribution is expected from such novel sources as solar power, biomass combustion, geothermal energy, or breeder reactors. No one source is credited with more than 15% of the total coverage of energy needs by the year 2000. R.D.V.

A77-33125 **Whatever happened to the Wankel engine.** F. Hirschfeld. *Mechanical Engineering,* vol. 99, May 1977, p. 28-31.

Appearance on the market of the first true industrial rotary engine, a stratified-charge rotary engine manufactured by Ingersoll-Rand under license from Curtiss-Wright, is discussed, along with the history and basics of the Wankel rotary engine. Problems with the cost of emissions control on the Wankel automotive rotary combustion engine used in the Toyo Kogo Mazda automobile are outlined. The new rotary engine is designed for driving a compressor in a gas pipeline system. R.D.V.

A77-33141 **Energy from the oceans - Requirements and capabilities.** A. F. Richards (Lehigh University, Bethlehem, Pa.). In: Ocean resources utilization; Proceedings of the Winter Annual Meeting, New York, N.Y., December 5-10, 1976. Meeting sponsored by the American Society of Mechanical Engineers. New York, American Society of Mechanical Engineers (Ocean Engineering Symposia Series. OED Volume 3), 1976, p. 91-129. 131 refs.

Eight methods, and a number of variants, of obtaining energy from the oceans are presented: ocean thermal, kelp bioconversion, ocean waves, tides and tidal currents, ocean winds, ocean currents, salinity gradients, and ocean geothermal. Each method is discussed in terms of concepts, geographic areas applicable, and development schedule and costs insofar as information is available. (Author)

A77-33159 # **Combined utilization of nuclear and organic fuels (Pro kombinovane vikoristannia atomnogo ta ogranichnogo paliva).** V. G. Nosach and P. L. Evtushenko (Akademiia Nauk Ukrains'koi RSR, Institut Tekhnichnoi Teplofiziki, Kiev, Ukrainian SSR). *Akademiia Nauk Ukrains'koi RSR, Dopovidi, Seriia A - Fiziko-Matematichni ta Tekhnichni Nauki,* Feb. 1977, p. 177-179. In Ukrainian.

The paper considers the possibility of integrating a nuclear thermal power reactor into a steam gas plant. The nuclear reactor would be used to provide heat for the vapor phase conversion of methane into carbon monoxide and oxygen. Thermodynamic calculations show that a 1.7-2 fold decrease in natural gas consumption in the steam-gas plant is possible due to utilization of nuclear-reactor heat. B.J.

A77-33170 # **Burnout of gaseous fuel in a tube combustion chamber with longitudinally distributed air supply (Vygoranie gazoobraznogo topliva v trubchatoi kamere sgoraniia s raspredelennym po dline podvodom vozdukha).** V. I. Didenko, Iu. A. Babenko, G. N. Liubchik, V. A. Khristich, and A. M. Shevchenko (Kievskii Politekhnicheskii Institut, Kiev, Ukrainian SSR). *Energetika,* vol. 20, Jan. 1977, p. 56-60. In Russian.

A77-33174 # **Formation of sulfuric anhydryde and nitrogen oxides in boilers at variable operating modes (Obrazovanie sernogo angidrida i okislov azota v kotlakh pri peremennykh rezhimakh raboty).** I. I. Strikha and A. S. Khomich (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Belorussian SSR). *Energetika,* vol. 20, Feb. 1977, p. 79-84. 9 refs. In Russian.

The formation of SO3 and nitrogen oxides in three steam generators (TP230, TP80, and TP87) during combustion of sulfur-containing black oil is investigated. The results show that the emission of toxic nitrogen oxides can be reduced by controlling such operational parameters as the load, the excess air, and secondary-air turbulence. A.Y.

A77-33273 **Jet fuel quality considerations.** M. W. Shayeson (General Electric Co., Aircraft Engine Group, West Lynn, Mass.). *Shell Aviation News,* no. 440, 1977, p. 26-31.

Two areas of fuel chemistry where fuel characteristics can conceivably exert an adverse effect on gas turbine jet engine performance, particularly in the long term, are delineated: fuel combustion characteristics and thermal stability. It is noted that fuels containing relatively high concentrations of aromatic compounds (with low hydrogen/oxygen ratios) will tend to form more exhaust smoke, combustor carbon deposits, and flame radiation. Aromatics content, smoke point, and hydrogen content of some representative fuel blends are compared. Aircraft engine performance on denser fuels of higher aromatics content, appropriate fuel tests, and practical tests of hydrogen content are discussed. R.D.V.

A77-33280 # **Energy from wastes.** I. J. Miller (Department of Scientific and Industrial Research, Chemistry Div., Petone, New Zealand). *New Zealand Energy Journal,* vol. 50, Mar. 25, 1977, p. 31-33. 14 refs.

The overall production of refuse in New Zealand is estimated to be about 3200 tons per day with a calorific value of approximately 11.6 GJ/t. Technical aspects of energy recovery and procedures for increasing the use of energy recovery systems are discussed. Consideration is given to the recycling of energy-intensive materials, the production of fuels, and the direct production of energy (usually in the form of heat). M.L.

A77-33283 **Solid waste incineration and energy recovery in hospitals.** L. T. Smith, R. A. Matula, and F.-K. Tsou (Drexel University, Philadelphia, Pa.). *Journal of Environmental Systems,* vol. 6, no. 4, 1976-1977, p. 303-320. 11 refs. NSF Grant No. GI-39566.

Small-scale, on-site incineration is examined as one practical method for disposing of hospital solid waste. On-site incineration-energy recovery systems are reviewed and potential annual savings of conventional fuel costs are computed as a function of bed capacity and fuel costs. Potential savings in a 500 bed hospital, for example, are found to range from 19,000 to 57,000 dollars per year for a fuel price range of one to three dollars per million Btu. A market survey of 492 hospitals in Pennsylvania, New Jersey and Delaware indicates a strong potential interest in on-site incineration-energy recovery systems. Potential blockages to the hospital market, such as particulate emissions and auxiliary fuel requirements, are discussed. (Author)

A77-33299 **Municipal solid waste recovery - A public or private risk.** J. G. Abert (National Center for Resource Recovery, Inc., Washington, D.C.). *Energy,* vol. 2, Spring 1977, p. 24-26.

The economic risks affecting public and private sponsors of solid waste recovery energy generating systems are discussed. Risk exists because the composition of the available waste might change; the technology might be inadequate, or be superseded; or market conditions might vary. A municipality risks that a high capital outlay for a new recovery system will make their community less competitive in the quest for funds from investors who are accustomed to low rates and traditional systems, while private operators risk sudden changes in waste delivery by municipalities. Cooperation between public and private concerns that can reduce costs and risks is recommended and the differing benefits to public and private sponsors are analyzed. M.L.

A77-33300 **Methanol gasoline blends - Future automotive fuels.** R. T. Johnson (Missouri-Rolla, University, Rolla, Mo.). *Energy,* vol. 2, Spring 1977, p. 27-29.

The characteristics of methanol/gasoline blends were determined by a number of tests. The Research Octane Number, RON, for blends increases with increased amounts of methanol while increased amounts of methanol have virtually no effect on the Motor Octane Number, MON. A high octane rating means the fuel has good anti-knock properties. The use of a 10% methanol/gasoline blend in comparison with unleaded gasoline alone results in a lower carbon monoxide emission and nonsignificant changes in the emission of unburned hydrocarbon and oxides of nitrogen. The addition of 10% methanol to the fuel reduces the ability of a cold engine to accelerate or idle smoothly. This blend, however, did not adversely affect the driveability of a Compound Vortex Controlled Combustion engine. Some problems that would be associated with widescale use of a 10% methanol/gasoline blend are: the driveability of some cars is severely reduced by the blend; contamination by a small amount of water can cause separation problems for the blend; and the presence of methanol would cause some corrosion problems. M.L.

A77-33301 **Energy from wood wastes.** P. N. Cheremisinoff (New Jersey Institute of Technology, Newark, N.J.) and A. C. Morresi (Exxon Research and Engineering Co., Florham Park, N.J.). *Environment,* vol. 19, May 1977, p. 25-31. 6 refs.

Recovery of salvageable raw materials and energy from large volumes of wood wastes produced in the lumber and paper/pulp industries, cost problems and disposal of wood wastes, and waste processing problems in producing useful combustible fuel are discussed, and wood waste-derived fuel is compared with industrial fuels used in steam generation. The Pacific Northwest Coast area (Oregon, Washington, British Columbia) figures in the discussion. Wood wastes can be derived mainly from processes (cuttings, chips, sawdust, wood and bark residues), but also from construction wood wastes, municipal solid wastes, driftwood, and wood damaged by pests, disease, and fire. Moisture content and dry weight of some economically significant wood species are compared, wood burning processes and process steps (evaporation of moisture, driving off volatiles; combustion) are compared, and air pollution problems with high-sulfur low-heating-value wood wastes are considered. R.D.V.

A77-33302 **An Otto for the automobile. II.** A. W. Reitze, Jr. (George Washington University, Washington, D.C.). *Environment,* vol. 19, May 1977, p. 32-42. 43 refs.

Variants of internal-combustion and external-combustion engines for propulsion of automotive vehicles are compared, and continued superiority in practice is reported for the traditional Otto engine, in a modified stratified-charge variant. Advantages and disadvantages of the stratified-charge Otto engine, Wankel rotary engine, Diesel engine, Brayton gas-turbine engine, and Stirling engine in automotive applications are compared, in some detail. The divided-chamber and open-chamber variants of the stratified-charge Otto engine are compared; the divided chamber currently features better control of pollutant emissions, while the open chamber boasts superior fuel economy. The need for an oxidation catalyst to control emissions of hydrocarbons and carbon monoxide in the exhaust stream is acknowledged. R.D.V.

A77-33303 **Waste economy and recycling: Problems and practice (Abfallwirtschaft und Recycling: Probleme und Praxis).** Edited by E. Keller. Essen, Verlag W. Girardet, 1977. 353 p. In German. $16.15.

The papers collected here investigate various aspects of establishing an industrial system in which a fundamental role is played by the recycling of industrial waste. The economic aspect of such a reorganization of industry is studied carefully, and a systems analytical approach to the realization of a waste economy is described. Economic and physical possibilities and limits of waste economical principles in individual industries are considered, for example, in the steel industry, nonferrous metals, agriculture and animal husbandry, the paper industry, and plastic and rubber products. The redeeming of waste heat and waste water is given special attention. P.T.H.

A77-33326 **World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volumes 1, 2 & 3.** Conference sponsored by the Energy Research and Development Administration and University of Miami. Edited by T. N. Veziroglu (Miami, University, Coral Gables, Fla.). Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976. Vol. 1, 703 p.; vol. 2, 832 p.; vol. 3, 716 p. Price of three volumes, $150.

The papers collected in these three volumes deal with advances in research on means of producing hydrogen, storing and transmitting hydrogen, and design of systems using hydrogen as fuel. Nuclear energy, solar energy, coal energy, thermochemical processes, and electrolytic processes are examined as the main energy sources and conversion processes. Other topics include transmission systems, cryogenic storage, hydrogen storage on highway vehicles, metal hydride storage and its material considerations, hydrogen as aircraft fuel, development of a liquid hydrogen car, and hydrogen safety problems. P.T.H.

A77-33327 # **Hydrogen production process by means of nuclear energy.** R. E. Harth and B. Hoehlein (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 1A-3 to 1A-17.

Some experimental investigations into the possibility of a combination of the steam reforming process with a high-temperature gas-cooled reactor (HTGR) are described. The pilot plant, EVA, consists of a single reforming tube with standard industrial dimensions. The heat transfer agent is helium. The main results are the hydrogen contents in the process gas mixture as a function of temperature and the temperature distributions as a function of tube length. A model was developed for the kinetics of the heterogeneous catalytic reaction of methane with steam on a nickel catalyst, and this model combined with pilot plant results serves as the basis for a computer program for optimizing reforming plant design. P.T.H.

A77-33328 # **The concept of 'nuclear hydrogen production' and progress of work in the Nuclear Research Center Juelich.** R. Schulten, H. Barnert, H. Fedders, G. Grziwa, and A. Schulte (Kernforschungsanlage Jülich GmbH, Jülich, West Germany). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 1A-19 to 1A-32. 14 refs.

The results of some experiments on the main processes in a nuclear hydrogen plant, consisting of a high-temperature reactor (HTR) plant coupled with a thermochemical cycle plant, are discussed. Hydrogen and oxygen yields for various sulfate cycles were obtained. Data were also obtained on the chlorination of magnesium hydroxyde chloride. Dimensional and performance data on some apparatus accomplishing coupling of HTR heat to the chemical processes are given. P.T.H.

A77-33329 # **The aqueous homogeneous reactor as a source of hydrogen and of process heat.** D. P. Majumdar, H. Reyes, and W. Kerr (Michigan, University, Ann Arbor, Mich.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 1A-81 to 1A-103. 9 refs.

The use of an aqueous homogeneous nuclear fission reactor for simultaneous hydrogen production by water radiolysis and process steam production is investigated. Two independent loops for hydrogen extraction are used, one for the core and one for the blanket. The primary supply of steam is generate by the core loop heat exchanger. Neutron leakage from core to blanket is calculated, and estimates of hydrogen and steam production are made. P.T.H.

A77-33330 # **Water splitting - A progress report.** J. L. Russell, Jr., K. H. McCorkle, J. H. Norman, J. T. Porter, II, T. S. Roemer, J. R. Schuster, and R. S. Sharp (General Atomic Co., San Diego, Calif.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 1A-105 to 1A-124. Research sponsored by the Northeast Utilities Service Co.; American Gas Association, and General Atomic Co.

This paper summarizes progress on the General Atomic Co. water splitting program begun in 1972. The search for cycles is discussed. The most promising cycle discovered by that search is described (an all liquid/gas cycle using sulfur and iodine), and the general constraints placed on any water splitting cycle by an HTGR heat source are discussed. (Author)

A77-33331 # **Hydrogen production from nuclear waste energy.** R. Hatami (Arya Mehr University of Technology, Teheran, Iran). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 2A-21 to 2A-41. 15 refs.

The basic formulas and temperature requirements for several schemes of hydrogen production by using steam and by water electrolysis are given. The use of residual electrical and steam energy of nuclear power plants for these processes is urged. The future program should be a combination of nuclear reactor and solar energy as a gamma-ray source for increasing efficiency of hydrogen production. P.T.H.

A77-33332 # **Peak power and heavy water production from electrolytic H2 and O2 using CANDU reactors.** M. Hammerli, W. H. Stevens, W. J. Bradley, and J. P. Butler (Atomic Energy of Canada, Ltd., Chalk River Nuclear Laboratories, Chalk River, Ontario, Canada). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 2A-42 to 2A-68. 26 refs.

A combined energy storage - heavy water production system is presented. Off-peak nuclear energy is stored in the form of electrolytic H2 (and O2) from which a large fraction of the deuterium has been transferred to water in an H2/H2O deuterium exchange catalytic column. The main features and advantages of the combined electrolysis-catalytic exchange D2O process are discussed. Significant quantities of D2O could be produced economically at reasonable peak to base power cost ratios. Thirty to forty percent of the primary electric energy should be available for peak energy via either gas-steam turbines or fuel cells. (Author)

A77-33333 # **Solar tower characteristics.** A. F. Hildebrandt and L. L. Vant-Hull (Houston, University, Houston, Tex.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 3A-3 to 3A-13. 18 refs. NSF Grant No. GI-39456.

The paper reviews the designs of the 100 MWe commercial solar towers and the 10 MWe pilot plants involving a steam-electric cycle. Geometric and material considerations are discussed and best design solutions found up to now are described. The basic characteristics of several thermo-chemical cycles of interest are mentioned. P.T.H.

A77-33334 # **Water-splitting-system synthesized by photochemical and thermoelectric utilizations of solar energy.** T. Ohta, N. Kamiya, M. Yamaguchi, N. Gotoh, T. Otagawa, and S. Asakura (Yokohama National University, Yokohama, Japan). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 3A-19 to 3A-30.

Valuable hybrid systems for hydrogen production by solar energy have been developed, and the system efficiency is estimated and discussed from various points of view. In order to split water into hydrogen and oxygen without draining out any by-products, a steady stream of the reacting materials should be maintained in the consecutive reaction processes, and if the system has a rate determining step, extra energy should be supplied to promote the reaction. In the Yokohama Mark 5, the efficiency of the thermoelectric device is as low as 5%; however, the overall efficiency of hydrogen production can be raised up to 20% by adding extra electric power. A hybrid system combining photochemical, thermochemical and electrochemical reactions are also discussed from energetic point of view. (Author)

A77-33335 # **Design of an ocean thermal energy plant ship to produce ammonia via hydrogen.** G. L. Dugger and E. J. Francis (Johns Hopkins University, Laurel, Md.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 3A-31 to 3A-68. 34 refs. Research supported by the Maritime Administration.

The 24 C temperature difference that exists between surface water and deep water at selected sites in tropical oceans can be used to drive a heat engine to produce electric power, electrolyze water, and produce ammonia from the resulting hydrogen plus nitrogen from the air. A baseline design has been developed for a 100-MWe Ocean Thermal Energy Conversion (OTEC) plant-ship that would produce 313 tons per day of ammonia. The cost estimates for this design have been extrapolated to 500-MWe plants to produce ammonia (for fertilizers and chemicals) or liquid hydrogen for shipment to the U.S. It is judged that ammonia will be producible at competitive cost ($90/ton in 1975 dollars) by 1982-85 with reasonable financing arrangements. (Author)

A77-33336 # **Synthetic fuels from solid wastes and solar energy.** M. J. Antal, Jr. (Princeton University, Princeton, N.J.), R. C. Feber, and M. C. Tinkle (California, University, Los Alamos, N. Mex.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1.
Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 3A-69 to 3A-88. 29 refs. U.S. Environmental Protection Agency Grant No. IAG-0646.

The basic reaction by which organic solid wastes in the presence of steam yield hydrogen and carbon dioxide is noted, and the possibilities of developing processes based on it for the production of significant amounts of hydrogen are examined. In particular, the option using solar tower as the heat source is discussed. Heating requirements are analyzed, and possible hydrogen production efficiency for a given system is roughly estimated to be at least 70%. An estimate of the overall economics of the system is provided. P.T.H.

A77-33337 # **The manufacture of hydrogen from coal.** C. L. Tsaros, J. L. Arora, and K. B. Burnham (IIT Institute of Gas Technology, Chicago, Ill.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 4A-3 to 4A-26.

Three processes for the conversion of coal to hydrogen: suspension gasification, fluidized bed gasification, and the fluidized steam-iron process, and a process for conversion of coal to methane are described and compared from the standpoint of overall plant efficiency. Overall conversion efficiency for coal to hydrogen is highest for the fluidized bed gasification process, which has lower oxygen and compression requirements than the suspension gasification process. The steam-iron process combines hydrogen manufacture with by-product heat energy. When a portion of the coal is converted to synthesis gas and this gas is used to hydrogenate more coal to methane, the conversion of coal to methane is more efficient than its conversion to hydrogen. P.T.H.

A77-33338 # **The K-T process - Koppers commercially proven coal and multi-fuel gasifier for synthetic gas production in the chemical and fertilizer industries.** R. Wintrell (Koppers Co., Inc., Pittsburgh, Pa.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 4A-27 to 4A-54.

A77-33339 * # **Hydrogen production from coal using a nuclear heat source.** R. N. Quade (General Atomic Co., San Diego, Calif.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1.
Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 4A-55 to 4A-66. NASA-sponsored research.

A strong candidate for hydrogen production in the intermediate time frame of 1985 to 1995 is a coal-based process using a high-temperature gas-cooled reactor (HTGR) as a heat source. Expected process efficiencies in the range of 60 to 70% are considerably higher than all other hydrogen production processes except steam reforming of a natural gas. The process involves the preparation of a coal liquid, hydrogasification of that liquid, and steam reforming of the resulting gaseous or light liquid product. A study showing process efficiency and cost of hydrogen vs nuclear reactor core outlet temperature has been completed, and shows diminishing returns at process temperatures above about 1500 F. A possible scenario combining the relatively abundant and low-cost Western coal deposits with the Gulf Coast hydrogen users is presented which provides high-energy density transportation utilizing coal liquids and uranium. (Author)

A77-33340 # **The calcium-iodine cycle for the thermochemical decomposition of water.** K. Fujii, W. Kondo, S. Mizuta, and T. Kumagai (National Chemical Laboratory for Industry, Tokyo, Japan). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1.
Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 5A-7 to 5A-18, 5A-20 to 5A-25. 24 refs.

A new cycle consisting of four reactions: the redox reaction of iodine with calcium hydroxide, thermal decomposition of calcium iodate, hydrolysis of calcium iodide and thermal dissociation of hydrogen iodide, was proposed for the thermochemical decomposition of water. Each of those reactions was experimentally confirmed and the thermal efficiency of this process was evaluated based on the material and heat flow sheet. (Author)

A77-33341 # **Progress in the Los Alamos Scientific Laboratory Program to develop thermochemical processes for hydrogen production.** M. G. Bowman (California, University, Los Alamos, N. Mex.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1.
Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 5A-27 to 5A-36. 6 refs. ERDA-sponsored research.

The need for experimental verification of conceptually plausible thermochemical processes for producing hydrogen is stressed. Proposed processes should be feasible with regard to cost of materials and chemicals, materials of construction, power requirements for the movement and separation of chemicals, and heat exchange and flow characteristics for permitting efficient heat transfer at realistic power densities. Since reactions with large entropy changes for cycles with a minimum number of reactions seem optimal, the use of gaseous reactants to achieve large entropies of reaction was considered. The following reactions involving sulfates or halides are described: oxide-sulfate cycles, sulfuric acid cycles, bromide-sulfate cycles, and sulfuric acid-sulfur cycles (with oxide or oxide and sulfide). M.L.

A77-33342 # **Feasibility studies of chemical reactions for thermochemical water splitting cycles of the iron-chlorine-, iron-sulfur- and manganese-sulfur-families.** K. F. Knoche, H. Cremer, G. Steinborn, and W. Schneider (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 5A-37 to 5A-82. 7 refs.

A77-33343 # **Discovery of reaction sequences for thermochemical water splitting.** D. May and D. F. Rudd (Wisconsin, University, Madison, Wis.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 6A-23 to 6A-49. 12 refs.

The thermodynamics of water-splitting reaction sequences are analyzed and a method for systematically discovering thermodynamically feasible closed-cycle chemical reaction sequences is presented. By utilizing a geometric representation of chemical reactions (the reaction polygon) stoichiometric integrity is obtained. It is suggested that this technique could aid in developing a water-splitting process which, driven by heat from nuclear reactions, would generate hydrogen for use as a fuel. M.L.

A77-33344 # **Effective conversion processes between thermal and chemical energies - Thermodynamic study of multistep water decomposition processes.** K. Yoshida and H. Kameyama (Tokyo, University, Tokyo, Japan). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 6A-51 to 6A-66. 11 refs.

A systematic search method for thermodynamically possible multistep water-splitting processes at high temperatures is described. Attention is directed to the evaluation of thermochemical water splitting processes by use of exergie flow chart and to the relationship between thermal efficiency and technological levels in thermochemical decomposition processes. The final test for overall thermal efficiency of a process should be done from a technical standpoint. S.D.

A77-33345 # **Balance and optimization procedure for thermochemical cycles for hydrogen production.** K. F. Knoche, H. Cremer, and W. Eisemann (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 6A-69 to 6A-80.

A computer program is presented for the balance and optimization of thermochemical cycles for hydrogen production. This program can be used for qualified choice of cycles as well as for the design and development of processes. The approach is demonstrated with respect to cycles of the iron-chlorine family. (Author)

A77-33346 * # **A thermochemical data bank for cycle analysis.** R. Carty, J. Funk, W. Conger, M. Soliman (Kentucky, University, Lexington, Ky.), and K. Cox. In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 6A-81 to 6A-86. 10 refs. Grant No. NGR-18-001-086.

The use of the computer program PAC-2 to produce a thermodynamic data bank for various materials used in water-splitting cycles is described. The sources of raw data and a listing of 439 materials for which data are presently available are presented. This paper also discusses the use of the data bank in conjunction with two other programs, CEC-72 and HYDRGN. The integration of these three programs implement an evaluation procedure for thermochemical water splitting cycles. CEC-72 is a program used to predict the equilibrium composition of the various chemical reactions in the cycle. HYDRGN is a program which is used to calculate changes in thermodynamic properties, work of separation, amount of recycle, internal heat regeneration, total thermal energy and process thermal efficiency for a thermochemical cycle. (Author)

A77-33347 # **The compatibility of containment materials for thermochemical hydrogen production.** F. Coen-Porisini and G. Imarisio (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerche, Ispra, Italy). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 7A-3 to 7A-57. 6 refs.

Chemical process equipment materials for full-scale thermochemical production of hydrogen by splitting of water are discussed in relation to compatibility with process streams. Experimental facilities for testing materials behavior in the severe corrosive environments anticipated are described. Corrosion phenomena are evaluated via gravimetric analysis, microscopic and SEM examinations, and X-ray diffraction analysis. The suitability and limitations of various ceramic compositions and metallic alloys are discussed. Materials for containment of corrosive halide streams and for chemical reactors and heat exchangers are evaluated. R.D.V.

A77-33348 # **Laboratory investigations on thermochemical hydrogen production.** J. Pangborn (ITT Institute of Gas Technology, Chicago, Ill.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 7A-59 to 7A-82. 20 refs. Research sponsored by the American Gas Association.

Methods of investigating thermochemical water-splitting cycles and the results of studies of a thermochemical cycle using CdO are described. The desired attributes of thermochemical cycles are analyzed as well as the techniques suitable for preliminary and advanced reaction trials. A water-splitting system based on the high-temperature thermal decomposition of CdO would be a hybrid cycle requiring a small electrical energy input for the first step in which Cd is converted to Cd(OH)2 and hydrogen is released from water. In tests this system exhibited hydrogen pressure capability, high energy efficiency, and noncorrosive components. A high-temperature solar furnace with a 1000 to 1200 C capability is considered a suitable prime energy source. M.L.

A77-33350 # **Hydrogen production by means of reactor heat using halogens and reversible electrochemical methods in a closed cycle process.** S. Dorner and K. Schretzmann (Gesellschaft für Kernforschung mbH, Karlsruhe, West Germany). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 8A-1 to 8A-47. 61 refs.

Two kinds of thermocyclic procedures for generating hydrogen are investigated. One approach involves the formation of nitrosyl chloride and the subsequent electrolysis of chloride products. Theoretical calculations suggest that less electric energy would be required by this procedure than is required in the electrolytic production of hydrogen from water. The second approach uses cesium in a procedure involving reversible electrochemical processes. Theoretical analysis suggests that the electricity produced by one step would be sufficient for the electricity requirement of another step so that the process, although coupled with electric energy, would only require (reactor) heat for operation. Experimental verification of these theoretical predictions is required. Other thermocyclic and electrolytic processes using halides are discussed. M.L.

A77-33351 # **Definition and analysis of thermochemical processes for hydrogen production based on iron-chlorine reactions.** A. Broggi, G. De Beni, and D. van Velzen (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerche, Ispra, Italy). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 8A-69 to 8A-81. 12 refs.

Activity on iron-chlorine cycles for hydrogen production is under way in many laboratories. The characteristics of these cycles are evaluated for their consequences on the overall thermal efficiency. The evaluation is made by the computer program OPTIMO. The results show that the thermal efficiency is strongly affected by the amount of heat related to the decomposition of irontrichloride, a reaction always present in these cycles. The necessity of careful attention to separation processes is underlined. (Author)

A77-33353 # **Thermochemical cycles utilizing sulfur for hydrogen production from water.** M. G. Bowman, E. I. Onstott, C. L. Peterson, and W. G. Witteman (California, University, Los Alamos, N. Mex.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 8A-109 to 8A-114. 5 refs. ERDA-sponsored research.

Three closed thermochemical cycles utilizing sulfur and metal oxides of calcium, lanthanum, and manganese have been demonstrated experimentally. All reactions give yields and proceed at rates considered reasonable. The reactions are based on the following steps: the equilibrium formation of sulfuric acid and sulfur from sulfur dioxide and water at low temperature; the high temperature decomposition of sulfuric acid to produce sulfur dioxide for recycle and to evolve oxygen; a reaction sequence involving metal oxide, metal sulfide, and metal carbonate for production of hydrogen sulfide from sulfur and water; and the decomposition of hydrogen sulfide to produce hydrogen and sulfur for recycle. M.L.

A77-33354 # **The Westinghouse Sulfur Cycle for the thermochemical decomposition of water.** L. E. Brecher, S. Spewock, and C. J. Warde (Westinghouse Research Laboratories, Pittsburgh, Pa.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 9A-1 to 9A-16. 9 refs.

A two-step thermochemical cycle for decomposing water into hydrogen and oxygen is described. Sulfurous acid and water are reacted electrolytically to produce hydrogen and sulfuric acid. The resultant sulfuric acid is vaporized to produce steam and sulfur trioxide, this last being subsequently reduced at higher temperatures into sulfur dioxide and oxygen. Water and sulfur dioxide are recycled, while oxygen is available as a byproduct. The cycle is considered to have the potential for achieving high thermal efficiencies while using common and inexpensive chemicals. Research indicates that the cycle chemical reactions proceed at acceptable rates without side reactions. Conceptual designs and cost estimates suggest that the product gas separations can be done conventionally and economically. The technology supporting the selection of this thermochemical cycle for further development, and potential applications for the hydrogen and oxygen products of the process, are discussed. M.L.

A77-33356 * # **Hydrogen production by water decomposition using a combined electrolytic-thermochemical cycle.** G. H. Farbman and L. E. Brecher (Westinghouse Electric Corp., Pittsburgh, Pa.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 1. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 9A-29 to 9A-50. Contract No. NAS3-18934.

A proposed dual-purpose power plant generating nuclear power to provide energy for driving a water decomposition system is described. The entire system, dubbed Sulfur Cycle Water Decomposition System, works on sulfur compounds (sulfuric acid feedstock, sulfur oxides) in a hybrid electrolytic-thermochemical cycle; performance superior to either all-electrolysis systems or presently known all-thermochemical systems is claimed. The 3345 MW(th) graphite-moderated helium-cooled reactor (VHTR - Very High Temperature Reactor) generates both high-temperature heat and electric power for the process; the gas stream at core exit is heated to 1850 F. Reactor operation is described and reactor innards are illustrated. A cost assessment for on-stream performance in the 1990's is optimistic. R.D.V.

A77-33358 # **Recent developments of large electrolytic hydrogen generators.** J. B. Laskin and R. D. Feldwick (Teledyne Energy Systems, Timonium, Md.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 6B-3 to 6B-19. 5 refs.

The paper examines the electrolytic-hydrogen market and electrolyzers, with particular reference to general plant description, module design, auxiliary design, and basic material costs. A new design of Teledyne's Electra Cell alkaline electrolysis hydrogen generators is discussed. A major conclusion is that the highest efficiency cell may not produce the least expensive hydrogen. S.D.

A77-33359 # **Prospects for hydrogen production by water electrolysis to be competitive with conventional methods.** S. Srinivasan and F. J. Salzano (Brookhaven National Laboratory, Upton, N.Y.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press 1976. p. 6B-23 to 6B-37. 14 refs. ERDA-supported research.

The cost of electrolytic hydrogen is about 2-3 times the cost of hydrogen produced from natural gas or naphta because of high electricity costs. With the increasing cost of coal and the impeding unavailability of oil and natural gas in a few years, the only alternative method for hydrogen production on a large scale can be by water electrolysis using electricity derived from nuclear or solar energy. Attention is directed to current status of advanced water electrolysis cells, effects of temperature on electrode kinetic parameters, electrocatalysis of hydrogen and oxygen evolution reactions, and use of mixed oxides as oxygen electrodes. Other subjects discussed include selection and evaluation of separator materials for water electrolysis cells, hydroxyl ion transporting solid polymer electrolyte, and photoelectrochemical effects. S.D.

A77-33360 # **Water electrolysis under pressure - Improvement of energy efficiency by temperature increase.** L. Mas (Société de Recherches Techniques et Industrielles, Buc, Yvelines, France), J. C. Sohm (Ecole Nationale Supérieure d'Electrochimie et d'Eletrométallurgie de Grenoble, St. Martin d'Hères, Isère, France), and A. Damien (Electricité de France, St. Denis, Seine-Saint-Denis, France). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 6B-41 to 6B-64. 14 refs. Research supported by the Electricité de France.

Ways of improving the energy efficiency of water electrolyzers are discussed. Since the optimum value of current density is determined by economic considerations, the best solution is achieved by decreasing the electrical resistance of the diaphragm, increasing the working temperature, and improving the activation of electrodes through development of new electrocatalysts. Particular attention is given to an assessment of temperature effect, from 40 to 160 C, on the performance of a water electrolyzer operating under a pressure of 20 bars with nonactivated electrodes. Also discussed are relevant corrosion problems when the temperature is raised from 80 to 160 C. S.D.

A77-33361 # **Performance characteristics of a high-pressure, moderate temperature, electrolysis system.** H. J. Allison (Oklahoma State University, Stillwater, Okla.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 7B-1 to 7B-22. NSF Grant No. GI-39457.

Electrolytic techniques of energy storage offer a flexibility of energy output unmatched by other storage techniques. Basic information on the hydrogen-oxygen electrolytic reaction is given. Theoretical and experimental evidence is presented in support of the significant improvements in cell performance which may result at high pressures and moderate temperature. Performance characteristics of a two-kilowatt electrolysis cell module prototype are discussed for initial testing conducted at temperatures up to 400 F and pressures up to 3000 psig. The electrolysis system developed provides for electrolyte replenishment without requiring pressure pumps or system depressurization, the number of valves and associated hardware being independent of the electrolysis system. S.D.

A77-33362 # **Development of a low capital cost electrolyzer.** B. C. Campbell (Billings Energy Research Corp., Provo, Utah). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 7B-23 to 7B-36. 17 refs.

The overall economic feasibility of electrolytic hydrogen production is analyzed in order to determine areas where improvement is needed to render this an attractive cost-effective source of hydrogen fuel. Various estimates of electrolytic hydrogen cost are discussed along with the operating and capital costs of different commercial units. Research areas where continued effort is needed to reduce the price of consumer hydrogen are identified. A new low-cost catalytic agent developed to increase the efficiency of large-scale units could prove to be a significant boon to the reduction of the capital costs of smaller devices. A new electrode design originally devised for the needs of a small electrolyzer may result in a dramatic improvement in the cost of bulk hydrogen. S.D.

A77-33363 * # **Heat transfer analysis of metal hydrides in metal-hydrogen secondary batteries.** M. Onischak, D. Dharia (Energy Research Corp., Danbury, Conn.), and D. Gidaspow (IIT Institute of Gas Technology, Chicago, Ill.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 7B-37 to 7B-52. Contract No. NAS3-18557.

The heat transfer between a metal-hydrogen secondary battery and a hydrogen-storing metal hydride was studied. Temperature profiles of the endothermic metal hydrides and the metal-hydrogen battery were obtained during discharging of the batteries assuming an adiabatic system. Two hydride materials were considered in two physical arrangements within the battery system. In one case the hydride is positioned in a thin annular region about the battery stack; in the other the hydride is held in a tube down the center of the stack. The results show that for a typical 20 ampere-hour battery system with lanthanum pentanickel hydride as the hydrogen reservoir the system could perform successfully. (Author)

A77-33364 # **Modern technology electrolysis for power application.** R. Bidard (Compagnie Electro-Mécanique, Paris, France) and U. La Roche (Brown, Boveri et Cie. AG, Baden, Switzerland). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 7B-53 to 7B-75.

A theoretical and practical comparison is drawn between thermolysis and electrolysis for hydrogen production by water splitting. Electrolysis possibilities are examined thoroughly with emphasis on market penetration. A number of reversible processes are described that may serve as models for further studies on actual thermolysis processes. Searching for an answer on where and when an effort should be made to apply modern technology to electrolysis for hydrogen production, one has to allocate the needs correctly in space, time, and cost. S.D.

A77-33365 # **Hydrogen production plants using electrolytic cells with low cost electrodes built into pressure tanks.** F. F. Hall (Stanford University, Stanford, Calif.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 7B-77 to 7B-108.

Electrolytic production method of generating hydrogen gas is briefly reviewed, and critical components of electrolytic hydrogen production plants are listed. These components are then discussed and recommended approaches and arrangements cited. Recommended arrangement would be operated at moderate temperatures and gas pipeline pressures. A hypothetical 150 MW hydrogen plant is described, including estimates of cost and performance. Comments are made in regard to several possible generating systems which might be used to power hydrogen production plants. A comprehensive energy policy is appended. (Author)

A77-33366 # **A farm energy system employing hydrogen storage.** R. R. Tison and N. P. Biederman (IIT Institute of Gas Technology, Chicago, Ill.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 4B-3 to 4B-28.

The paper provides some insight into the possible use of hydrogen as an energy link between a wind turbine and the ultimate energy demands of a farming operation. Emphasis is placed on determining whether current technology for hydrogen production and storage, and battery storage can be combined with a wind turbine to provide reliable energy to farming operations and rural homes. Initial findings are presented in terms of the application of hydrogen and thermal (hot water) storage of energy produced by wind power for a 100-head dairy farm. It is anticipated that after optimization, a wind energy system for farms incorporating hydrogen and hot water storage could produce energy at 10 to 15 cents per kWhr with current technology. S.D.

A77-33367 # **Microbial hydrogen production.** J. E. Zajic and J. Brosseau. In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 4B-29 to 4B-68. 100 refs.

A comparison of fuel properties of nonfossil and other fuels reveals that hydrogen is an ideal fuel not only as an alternative primary energy source but also as a highly efficient energy carrier. The four basic processes available for hydrogen production from nonfossil primary energy sources are electrolytic, thermomechanical, radiolytic, and microbial. The paper is a brief review of microbial production of hydrogen. Primary environmental factors determining the outcome of enrichment procedures for some chemoautotrophic and chemoheterotrophic bacteria are identified. The biochemistry of hydrogen gas production by microorganisms is discussed for 'clostridial' and 'coli-type' reactions. Also discussed are the nitrogenase relationship to hydrogen synthesis and the use of photosynthetic bacteria. S.D.

A77-33368 # **The photosynthetic production of hydrogen.** G. Neil, J. O. Bockris, J. F. McCann (South Australia, Flinders University, Adelaide, Australia), and D. J. D. Nicholas (Adelaide, University, Adelaide, Australia). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 4B-69 to 4B-76. 10 refs.

The rate of hydrogen produced from Anabaena cylindrica under an inert atmosphere and light irradiation has been examined. An approximate estimate of the area required to produce hydrogen in adequate quantities from Anabaena cylindrica to provide enough energy for the needs of a city with a population of 1 million has been calculated. (Author)

A77-33369 # **Bioconversion of solar energy in salt water photosynthetic hydrogen production systems.** A. Mitsui (Miami, University, Miami, Fla.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 4B-77 to 4B-99. 14 refs. Research supported by the Gulf Oil Foundation, Engineering Foundation, and NSF.

Progress and future plans in the study of hydrogen photoproduction via marine photosynthetic systems are reviewed. Special emphasis is placed on the economic and logistical importance of using salt water as the hydrogen (proton) and electron donor in such a system. The advantages of using marine photosynthetic microorganisms (i.e., marine photosynthetic bacteria and marine blue-green algae) are discussed from the standpoint of maintaining stable mass cultures with high solar conversion efficiencies. A program is outlined for the multiple utilization of hydrogen-producing mass cultures, including harvesting cultures for food production, using cellular products for methane production and isolating metabolically active cellular products for medical use. (Author)

A77-33370 # **The theory of hydrogen production in a photoelectrochemical cell.** J. O. Bockris and K. Uosaki (South Australia, Flinders University, Bedford Park, Australia). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 5B-1 to 5B-30. 25 refs.

Theoretical expressions for photocurrents of p-type and n-type semiconductors are set up under estimation that the rate-determining step is discharge process in both cases. The photoelectrochemical process in semiconductors is considered in terms of the solid state and quantum electrochemical processes involved. Photocurrents of individual electrodes were calculated by using the characteristics of semiconductors, e.g., energy gap, electron affinity, etc. The calculated results for n-type semiconductors are rather low in any cases. The experimental high quantum efficiency for TiO2 is explained by considering the existence of surface state. Photocurrent for whole cell is also considered, and hydrogen production rate under solar spectrum by a typical cell is calculated. (Author)

A77-33372 # **Feasibility of hydrogen production by direct water splitting at high temperature.** S. Ihara (Ministry of International Trade and Industry Electrotechnical Laboratory, Tonashi, Tokyo, Japan). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 5B-55 to 5B-70. 8 refs.

Conceptual study on the process of hydrogen production by direct dissociation of water using high-temperature solar energy is described. Calculated result of equilibrium composition of water vapor, hydrogen, and oxygen suggests that the temperatures above 3000 K are required for the dissociation of water. A solar furnace for supplying such high-temperature energy is considered. Basic ideas on the method for separating hydrogen and oxygen from high-temperature water vapor are suggested. Analysis of overall efficiency and target cost shows that the process will be justified for practical use if an effective separation method can be developed. (Author)

A77-33374 * # **Thermodynamic analysis of alternate energy carriers, hydrogen and chemical heat pipes.** K. E. Cox (New Mexico, University, Albuquerque, N. Mex.), R. H. Carty, W. L. Conger, M. A. Soliman, and J. E. Funk (Kentucky, University, Lexington, Ky.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 1B-3 to 1B-16. 14 refs. Research supported by the Westinghouse Electric Corp., Electric Power Research Institute and NASA.

The paper discusses the production concept and efficiency of two new energy transmission and storage media intended to overcome the disadvantages of electricity as an overall energy carrier. These media are hydrogen produced by water-splitting and the chemical heat pipe. Hydrogen can be transported or stored, and burned as energy is needed, forming only water and thus obviating pollution problems. The chemical heat pipe envisions a system in which heat is stored as the heat of reaction in chemical species. The thermodynamic analysis of these two methods is discussed in terms of first-law and second-law efficiency. It is concluded that chemical heat pipes offer large advantages over thermochemical hydrogen generation schemes on a first-law efficiency basis except for the degradation of thermal energy in temperature thus providing a source of low-temperature (800 K) heat for process heat applications. On a second-law efficiency basis, hydrogen schemes are superior in that the amount of available work is greater as compared to chemical heat pipes. S.D.

A77-33375 # **Ocean thermal energy delivery systems based on chemical energy carriers.** A. Konopka, A. Talib, N. Biederman, and B. Yudow (IIT Institute of Gas Technology, Chicago, Ill.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 1B-19 to 1B-37. 23 refs. ERDA-supported research; NSF Grants No. C-1008; No. AER-75-00033.

Application of chemical energy carriers to deliver ocean thermal energy is reviewed. The technoeconomic requirements to convert thermal-gradient-produced shaft power into hydrogen and ammonia are discussed. Subsequent offshore chemical energy transmission and onshore terminal costs and technical requirements are also discussed. A preliminary comparison of hydrogen and ammonia, as ocean thermal energy carriers, is made. (Author)

A77-33376 # **A wind energy system utilizing high pressure electrolysis as a storage mechanism.** H. J. Allison (Oklahoma State University, Stillwater, Okla.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 2B-3 to 2B-14. 7 refs.

The paper describes a technique of energy storage which utilizes electrolysis cells to disassociate water into its component gases, and then stores the evolved hydrogen as a high pressure gas, or liquid, or hydride. This system, in conjunction with solar and wind energy generating systems, has been the subject of research since 1961. Present performance parameters for those components of the system which have reached the prototype stage are provided, and remaining problems and economic considerations are discussed. M.L.

A77-33377 * # **A study of the efficiency of hydrogen liquefaction.** C. R. Baker and R. L. Shaner (Union Carbide Corp., Linde Div., Tonawanda, N.Y.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 2B-17 to 2B-41. 9 refs. Contract No. NAS1-13395.

The search for an environmentally acceptable fuel to eventually replace petroleum-based fuels for long-range jet aircraft has singled out liquid hydrogen as an outstanding candidate. Hydrogen liquefaction is discussed, along with the effect of several operating parameters on process efficiency. A feasible large-scale commercial hydrogen liquefaction facility based on the results of the efficiency study is described. Potential future improvements in hydrogen liquefaction are noted. S.D.

A77-33378 # **A system consideration of the cryogenic storage tank for liquid hydrogen fueled vehicles and the resulting tank concept for a passenger car.** W. Peschka and C. Carpetis (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Energiewandlung und Elektrische Antriebe, Stuttgart, West Germany). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 2B-43 to 2B-63. 46 refs.

A cryogenic liquid hydrogen fuel tank, designed for automobiles which use hydrogen for fuel, is described. Consideration is given to liquid hydrogen as an alternative fuel, liquid hydrogen storage in a vehicle, and fuel processing. Performance data and test results involving a compact cryogenic fuel tank are provided. M.L.

A77-33379 # **Technical and environmental aspects of underground hydrogen storage.** A. B. Walters (Southern California Gas Co., Los Angeles, Calif.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 2B-65 to 2B-79.

The storability of energy in the form of hydrogen supplies is emphasized and underground hydrogen storage is compared with liquefied hydrogen storage. The storage technology developed for natural gas, using underground aquifers and depleted petroleum reservoirs, is considered well adapted to hydrogen storage needs; required further studies are indicated. Estimated costs of hydrogen storage and natural gas storage (reservoir and surface acquisition,

wells, compression and injection wells, cushion gas, operating and maintenance, energy input) are compared, and environmental effects (land use, waste water, air quality and emissions) of hydrogen storage underground are discussed. R.D.V.

A77-33380 # **Hydrogen storage on highway vehicles - Update '76.** E. E. Ecklund (ERDA, Washington, D.C.) and F. L. Kester (IIT Institute of Gas Technology, Chicago, Ill.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 3B-3 to 3B-29. 35 refs.

The paper presents a brief overview of some of the more recent work on hydrogen storage media and a rudimentary comparison of these storage methods. In addition to the vehicle weight comparisons, a comparison of overall fuel utilization efficiencies for the various storage concepts is made. The net efficiencies are compared for the conversion of coal or nuclear fuel to a transportable fuel, transmission of the fuel to the vehicle, and the net work performed by the vehicle on the road. Factors influencing the near-term potential of hydrogen-fueled highway vehicles, especially in relation to electric vehicles, are identified. It is shown that hydrogen-fueled vehicles will not be competitive with electric vehicles until large-scale hydrogen production facilities are developed. S.D.

A77-33381 # **Hydrogen vehicular fuel storage as a step in a water splitting cycle.** P. S. Rudman (Technion - Israel Institute of Technology, Haifa, Israel). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 3B-31 to 3B-39. 9 refs.

The paper shows that a unique refueling cycle is possible for hydrogen produced in a thermochemical water-splitting cycle, where fuel production for hydrogen vehicular refueling is an integral part of the refueling loop. Chemical reactions of hydrogen release for fuel storage are identified and discussed, along with acceptance criteria for fuel storage systems. Merits and short-comings of such a hydrogen refueling system are pointed out. S.D.

A77-33382 # **Hydrogen-powered highway vehicles - Applications and optimum form of fuel storage.** R. L. Whitelaw (Virginia Polytechnic Institute and State University, Blacksburg, Va.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 3B-41 to 3B-51. 6 refs.

Twelve different vehicle applications are considered for the future era of hydrogen as fuel. It is shown that seven different stored energy quantities, from 100,000 to 8,000,000 Btu will accommodate all. Optimum tank sizes and weights for each are then determined, both for liquid hydrogen at 2 atm, 23 K, and for pressurized hydrogen at 102 atm, 288 K. Liquid hydrogen storage, in well-insulated tankage, is shown to be 1/50th the weight and 1/15th the cost of pressurized gas storage, for the same energy, besides being much safer. The use of liquefied natural gas (LNG), so long as available, enjoys a 50% weight and cost advantage over liquid hydrogen for tankage alone. Two million Btu of liquid hydrogen, sufficient for a 400-mile family car trip, may be stored in two 43-in. long by 8 in. diam. insulated tanks for a total tank weight of 70 lb and cost of $263. (Author)

A77-33383 # **Methods of on-board generation of hydrogen for vehicular use.** A. Z. Ullman and W. D. Van Vorst (California, University, Los Angeles, Calif.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 3B-53 to 3B-62.

The paper reviews some possible alternatives of hydrogen storage for use as the sole or major fuel for vehicular use and as a supplementary fuel for enhancement of the combustion behavior. Energetics of hydrogen as a supplementary vehicular fuel is analyzed. Chemical storage of hydrogen for vehicular use is discussed relative to borohydrides, methanol decomposition, and ammonia decomposition. Conditions under which the net thermal efficiency of the engine can be improved with hydrogen storage are identified. S.D.

A77-33384 # **Automotive fuel-saving system with on-board hydrogen generation and injection into I. C. engines.** D. A. Kelly (Technidynamics, Inc., Maspeth, N.Y.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 3B-63 to 3B-70.

The paper describes the design concept and capabilities of a new automotive fuel-saving system provided with on-board hydrogen generation and injection means. The system consists of three basic groups of units: electrical generating units, hydrogen generating cell array, and hydrogen injection aggregate. The heart of the system is the high-efficiency electrolysis multicell unit that produces the hydrogen gas for injection into the basically unaltered internal-combustion automotive engine. Key factors for the adoption of this on-board generation system are the relative ease of hydrogen adaptation for use in conventional internal-combustion engines and its pollution-free clean burning characteristic. S.D.

A77-33385 # **Titanium alloy hydrides - Their properties and applications.** J. J. Reilly and J. R. Johnson (Brookhaven National Laboratory, Upton, N.Y.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 8B-3 to 8B-26. 15 refs. ERDA-sponsored research.

Certain reversible metal hydrides have been proposed as energy storage media. One of these, titanium iron hydride, has already been used in a pilot scale demonstration for this purpose. This paper will discuss the formation and properties of other titanium alloy hydrides which are also of interest in this connection. Particular emphasis will be given to a class of ternary alloys having composition corresponding to TiFe(x)M(y) where M is a transition metal. It has been determined that many alloys of this type will react directly and reversibly with hydrogen to form hydrides. The properties of these hydrides vary and are dependent on the particular transition metal substitute and its quantity. The integration of such materials with energy storage systems and their relative advantages are discussed. (Author)

A77-33386 # **The behavior of iron titanium hydride test beds - Long-term effects, heat transfer and modeling.** G. Strickland, J. Milau, and W.-S. Yu (Brookhaven National Laboratory, Upton, N.Y.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 8B-41 to 8B-71. Research supported by the Empire State Electric Energy Research Corp.

Hydrogen and the intermetallic compound FeTi react to produce iron titanium hydride. The decomposable nature of iron titanium hydride makes it a suitable hydrogen storage medium, and it has the advantage over hydrides of reacting reversibly at ordinary temperatures and being made from a potentially low-cost material. The long term and thermal behavior of test beds of iron titanium hydride is assessed. Particular attention is given to microfissuring and particle attrition during the activation of a decomposable hydride and to reaction rates during hydriding and dehydriding as being dependent on the system pressure and the material temperature and composition. Modeling studies are carried out to assess the dynamic behavior of a hydride bed and establish the effect of system variables on the hydriding and dehydriding rates. The results are suitable for optimizing the design of larger units. S.D.

A77-33387 # **A thermodynamic analysis of HYCSOS, a hydrogen conversion and storage system.** D. M. Gruen, F. Schreiner,

and I. Sheft (Argonne National Laboratory, Argonne, Ill.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 8B-73 to 8B-87. 13 refs.

A two metal hydride system for the storage, retrieval and conversion of thermal energy is described. The system functions - heating, cooling and power production - are discussed for solar energy applications. A thermodynamic analysis particularly of the conversion cycle is presented. It is concluded that solar concentrators providing heat transfer fluid temperatures of 140 deg could give conversion efficiencies of 16.5%. (Author)

A77-33388 * # A simple approach to metal hydride alloy optimization. D. D. Lawson, C. G. Miller, and R. F. Landel (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 9B-3 to 9B-10. 6 refs. Contract No. NAS7-100.

Hildebrand-Scott (1950) solubility parameters can be obtained for metals and alloys by calculating the cohesive energy density (CED), equal to the square of the solubility parameter, and a function of the heat of sublimation and the atomic volume. It is suggested that the solubility parameter permits estimation of the hydrogen storage capacity of an alloy and that alloys with a solubility parameter approximately equal to the parameter for hydrogen will have greater hydrogen storage capacity than other alloys. Equilibrium pressure - temperature relationships for some metal hydrides are presented in conjunction with the calculated solubility parameter and correlated with characteristics which would be useful in hydrogen-powered vehicles. Alloy properties which increase the amount of nonstoichiometric reversible hydrogen absorption are discussed. M.L.

A77-33389 * # Potential structural material problems in a hydrogen energy system. H. R. Gray (NASA, Lewis Research Center, Cleveland, Ohio), H. G. Nelson (NASA, Ames Research Center, Moffett Field, Calif.), R. E. Johnson (NASA, Johnson Space Center, Houston, Tex.), W. B. McPherson (NASA, Marshall Space Flight Center, Huntsville, Ala.), F. S. Howard (NASA, Kennedy Space Center, Cocoa Beach, Fla.), and J. H. Swisher (ERDA, Washington, D.C.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2.
Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 9B-15 to 9B-39. 49 refs.

Potential structural material problems that may be encountered in the three components of a hydrogen energy system - production, transmission/storage, and utilization - have been identified. Hydrogen embrittlement, corrosion, oxidation, and erosion may occur during the production of hydrogen. Hydrogen embrittlement is of major concern during both transmission and utilization of hydrogen. Specific materials research and development programs necessary to support a hydrogen energy system are described. An awareness of probable shortages of strategic materials has been maintained in these suggested programs. (Author)

A77-33390 # Selection of structural materials for hydrogen pipelines and storage vessels. A. W. Thompson (Rockwell International Science Center, Thousand Oaks, Calif.) and I. M. Bernstein (Carnegie-Mellon University, Pittsburgh, Pa.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 2. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 9B-47 to 9B-65. 38 refs. Research supported by the Rockwell Independent Research and Development Program; Contract No. N00014-75-C-0265.

The feasibility, both of using present transmission lines for hydrogen, and of developing new steels resistant to hydrogen, is explored. Both appear possible but simple extrapolation of existing conditions for natural gas storage and transmission is inappropriate. Specifically, composition, heat treatment and weldability requirements are more severe for hydrogen transport; pressure vessel steels are susceptible to hydrogen embrittlement and thus seamless vessels and/or protective liners are required; and high-strength resistant steels must be developed for compressors, valves and related equipment. These problems, while soluble, provide an urgent challenge to the materials engineer. (Author)

A77-33391 * # Some early perspectives on ground requirements of liquid hydrogen air transports. P. F. Korycinski (NASA, Langley Research Center, Hampton, Va.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 5C-33 to 5C-56. 10 refs.

The paper examines the problem of liquid-hydrogen (LH2) subsonic long-range air transport from the perspectives of airplane manufacturers, the airline operator, the air terminal authority and the LH2 supplier. Emphasis is placed on identifying common problems and interfaces that are likely to occur in preparing for commercial airline operations of LH2 subsonic air transport in the 1990-1995 period. General considerations are discussed relative to sources and cost of gaseous hydrogen, hydrogen liquefaction, and LH2 availability. The fact that hydrogen sustains combustion at altitudes substantially higher than hydrocarbon fuels suggests that air transport can be designed to operate at higher enroute air traffic flight levels. This can be an advantage if only to relieve traffic congestion on heavily traveled routes. Pertinent interfaces in planning for the use of LH2 in air transportation are identified, including productivity and profitability, passenger-fuel compatibility, and lightning and electrical discharges. S.D.

A77-33392 * # New potentials for conventional aircraft when powered by hydrogen-enriched gasoline. W. A. Menard, P. I. Moynihan, and J. H. Rupe (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 5C-59 to 5C-86. 11 refs. Contract No. NAS7-100.

Hydrogen enrichment for aircraft piston engines is under study in a new NASA program. The objective of the program is to determine the feasibility of inflight injection of hydrogen in general aviation aircraft engines to reduce fuel consumption and to lower emission levels. A catalytic hydrogen generator will be incorporated as part of the air induction system of a Lycoming turbocharged engine and will generate hydrogen by breaking down small amounts of the aviation gasoline used in the normal propulsion system. This hydrogen will then be mixed with gasoline and compressed air from the turbocharger before entering the engine combustion chamber. The paper summarizes the results of a systems analysis study. Calculations assuming a Beech Duke aircraft indicate that fuel savings on the order of 20% are possible. An estimate of the potential for the utilization of hydrogen enrichment to control exhaust emissions indicates that it may be possible to meet the 1979 Federal emission standards. (Author)

A77-33393 # Fuel subsystem characteristics for LH2 aircraft. A. M. Momenthy (Boeing Commercial Airplane Co., Seattle, Wash.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3.
Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 5C-87 to 5C-102.

Design characteristics of the fuel subsystem for subsonic LH2 (liquid hydrogen) fueled commercial aircraft are discussed in terms of requirements and technology availability. Some of the differences between LH2 systems developed for space vehicles and those required for commercial aircraft are pointed out. Significant areas of

technology requiring advancement and long lead time development testing are identified. The material presented reflects the results obtained from a Boeing study covering the development of a candidate fuel subsystem for a 3000 nautical mile range LH2 fueled commercial airplane. (Author)

A77-33394 # **Development of a liquid hydrogen car.** S. Furuhama, M. Hiruma, and Y. Enomoto (Musashi Institute of Technology, Tokyo, Japan). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 6C-27 to 6C-58. 12 refs.

The design concept and efficiency of a car provided with liquid hydrogen as the vehicular fuel are described. A Datsun B210 930 kg weight small passenger car was modified into a vehicle with a liquid hydrogen tank. The modifications were made relative to introduction of cold hydrogen gas, mechanical fuel injection into intake port, a two-step fuel control device, control of mixture ratio, improvement of compression ratio, piston ring performance, spark plug and timing, and backfire caused by intake valve seat made of copper alloy. Test results of the modified engine on the bench are discussed. As a result of the complete running of the car on the public road together with usual cars in long distance such as 2800 km, it is demonstrated that liquid hydrogen has a bright future as a carrying medium of automobiles. An ideal system of the liquid-hydrogen car should have a cassette type liquid-hydrogen tank, from which liquid hydrogen is fed to the small-volume high-pressure gas reservoir, and high-pressure hydrogen gas is to be injected into the combustion chamber of the engine. S.D.

A77-33395 # **Dynamic tests of hydrogen-powered IC engines.** R. L. Woolley (Billings Energy Research Corp., Provo, Utah) and G. J. Germane (Brigham Young University, Provo, Utah). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 6C-59 to 6C-74. 6 refs.

Two analyses are performed to investigate the dynamic effect on hydrogen engine efficiency. A speed governed, sawtooth, torque time cycle is proposed for use in checkout and calibration of computer controlled engine test cells. This cycle makes possible comparison of integrated steady-state data with dynamic test results. Integration of available data indicates that a factor of 1.5 (50% improvement) is a valid number for estimation of hydrogen engine efficiency from a knowledge of gasoline efficiency. Vehicle driving dynamics for a transit vehicle are simulated for a simplified road cycle. An example calculation indicates that the efficiency penalty resulting from the addition of a 4000 lb metal hydride tank is more than offset by efficiency benefits in the hydrogen engine. In this example, the energy savings with a heavier, hydrogen-powered transit vehicle was predicted to be nearly 30%. (Author)

A77-33396 # **Modification techniques and performance characteristics of hydrogen-powered IC engines - State of the art, 1975.** F. B. Simpson, J. H. Lofthouse, D. R. Swope (Idaho National Engineering Laboratory, Idaho Falls, Idaho), and R. L. Woolley (Billings Energy Research Corp., Provo, Utah). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 6C-75 to 6C-95. 31 refs.

The past decade has seen renewed interest in hydrogen as a fuel for internal combustion engines due to reduction of automotive pollution in urban areas and due to fuel shortages and dramatic increase in petroleum fuel costs. A result of this renewed interest has been the conversion of a variety of sizes and kinds of internal combustion engines to operate on hydrogen fuel. The paper outlines the engine modification techniques and performance characteristics of hydrogen-fueled engines so that the state of the art can be more readily visualized. Methods of power regulation and other modifications are discussed along with fuel storage systems and some reasons for engine efficiency enhancement with hydrogen fuel. The metal-hydride form of fuel storage in conjunction with an internal combustion engine shows definite advantages in performance, weight, total cost, and refueling time when compared to electric vehicles with battery storage. Hydrogen-air systems can be designed to meet government pollution emission standards. S.D.

A77-33397 * # **Crash test of a liquid hydrogen automobile.** J. G. Finegold (California Institute of Technology, Jet Propulsion Laboratory, Pasadena; California, University, Los Angeles, Calif.) and W. D. Van Vorst (California, University, Los Angeles, Calif.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 6C-97 to 6C-111.

Details of the conversion of a U.S. Postal Service mail truck to hydrogen-fueled operation are given. Specific reference is made to design safety considerations. A traffic accident is described that caused the mail truck (mounted on a trailer) to turn on its side at approximately 20 mph and to finally slide to a stop and turn upside down. No one was injured, and there was essentially no damage to the liquid hydrogen fuel system. The mail truck was driven away from the scene of the accident. Suggestions to insure the safety of hydrogen-fueled experimental vehicles are made. (Author)

A77-33398 # **Prototype hydrogen automobile using a metal hydride.** D. L. Henriksen, D. B. Mackay, and V. R. Anderson (Billings Energy Research Corp., Provo, Utah). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 7C-1 to 7C-12.

A 1975 Pontiac Grand Ville has been converted to run on hydrogen. This paper presents details of the engine conversion, of the design of the iron-titanium storage system, and of the design of related controls and safety equipment. Engine modifications include increase in compression ratio, conversion of the carburetor for water induction, and changes in the ignition system. Power control is obtained by throttling the air-hydrogen mixture. Waste heat from the engine exhaust is circulated through the hydride tank to drive off hydrogen. Controls are provided for regulating waste heat and hydrogen pressure. The method for recharging the system is also described. (Author)

A77-33399 # **Automotive hydride tank design.** D. B. Mackay (Billings Energy Research Corp., Provo, Utah). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 7C-13 to 7C-23.

The paper presents heat exchange data and results from theoretical studies and prototype testing for automotive hydride tanks designed as pressure vessels and heat exchangers. Thermal conductivity of hydrides is analyzed along with heat exchange in hydride-filled tubes and design calculations for heat exchangers. It is shown that a tube bundle with the hydride on the inside appears to be the logical configuration that satisfies the design requirements. The equations derived in the paper, along with pertinent data on heat transfer, can be used to make preliminary designs. S.D.

A77-33400 # **A hydrogen-powered mass transit system.** R. E. Billings (Billings Energy Research Corp., Provo, Utah). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 7C-27 to 7C-40. 18 refs.

Hydrogen's application to mass transit systems is considered. A 21-passenger bus is converted to hydrogen using a Dodge engine

which has been modified for high compression operation. Backfiring and nitric oxide pollution formation are controlled by a water injection technique. Hydrogen fuel storage for the experimental prototype is accomplished by two metal hydride containers using an iron-titanium alloy. Data are presented regarding equipment conversion and design, energy resource utilization, economics, and safety. (Author)

A77-33401 # **Use of hydrogen in automotive engines.** C. P. Gupta (Roorkee, University, Roorkee, India). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 7C-47 to 7C-70. 14 refs.

From considerations of environmental pollution and precarious supply of hydrocarbon fuels, the use of hydrogen in internal combustion engines is an attractive proposition. The paper reviews the development and present status of this engine with particular reference to automotive applications. Different methods of using hydrogen as automotive engine fuel are examined. It is shown that both cryogenic and metal hydride storage systems can be used on a vehicle. The hydrogen-oxygen Rankine cycle power plant, although quite attractive from the standpoint of vehicle weight and range, requires the development of entirely new hardware and a cooled steam turbine. The production, transportation, storage and distribution of hydrogen do not present any serious technical problem, nor does the use of hydrogen fuel in internal combustion engines pose any special safety hazard. S.D.

A77-33402 # **Hydrogen safety problems.** R. Reider and F. J. Edeskuty (California, University, Los Alamos, N. Mex.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 8C-9 to 8C-15.

In the consideration of widespread use of hydrogen as a fuel, low pollution, recyclability and high efficiency are obvious advantages. Disadvantages of such use are those of introducing new fuel distribution and use systems including additional investment, problems of fuel storage and the traditional objection of accident hazards. Hazardous situations are discussed in terms of impurities, hydrogen combustion characteristics, asphyxiation and unconfined and confined hydrogen/air deflagrations. Effects of cryogenic hydrogen are assessed relative to pressure buildup, condensation, oxygen enrichment, and cold injury. Classical techniques in the field of accident prevention will contribute to safety and acceptance of hydrogen as a common energy form. S.D.

A77-33403 # **Commodity hydrogen from off-peak electricity.** K. Darrow, N. Biederman, and A. Konopka (IIT Institute of Gas Technology, Chicago, Ill.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 8C-17 to 8C-45. 10 refs. Research sponsored by the Electric Power Research Institute.

This paper considers the use of off-peak electrical power as an energy source for the electrolytic production of hydrogen. The present industrial uses for hydrogen are examined to determine if hydrogen produced in this fashion would be competitive with the industry's onsite production or existing hydrogen prices. The paper presents a technical and economic feasibility analysis of the various components required and of the operation of the system as a whole including production, transmission, storage, and markets. (Author)

A77-33404 * # **Technical prospects for commercial and residential distribution and utilization of hydrogen.** J. Pangborn, M. Scott, and J. Sharer (IIT Institute of Gas Technology, Chicago, Ill.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 8C-47 to 8C-73. 16 refs. Contract No. NAS8-30757.

Various investigators have assumed that hydrogen will be compatible with conventional gas delivery systems and that, with minor modifications, hydrogen can be utilized in existing equipment for heating and cooking. The paper addresses some of the issues of concern in the compatibility of natural gas systems with hydrogen and hydrogen mixtures and identifies areas for which tests, research, or development are appropriate. Requirements to be met by atmospheric burners built for most commercial and residential gas appliances are discussed. Expected modifications to appliances for satisfactory operation with hydrogen are closing the primary air shutters, replacing the burners, adjusting the appliance gas regulator for proper delivery pressure, and possibly replacing the gas regulator or its vent. S.D.

A77-33405 * # **Energy storage possibilities of atomic hydrogen.** R. D. Etters (Colorado State University, Fort Collins, Colo.), J. V. Dugan, Jr. (U.S. Congress, Science and Technology Committee, Washington, D.C.), and R. Palmer (NASA, Lewis Research Center, Cleveland, Ohio). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 9C-3 to 9C-20. 13 refs. Grant No. NGL-06-002-159.

The possibility of storing large amounts of energy in a free radical system such as atomic hydrogen is analyzed. Attention is focused on theoretical calculations of the ground state properties of spin-aligned atomic triplet hydrogen, deuterium, and tritium. The solid-liquid phase transition in atomic hydrogen is also examined. S.D.

A77-33406 # **An examination of the stirred reactor as a tool for the determination of rate constants of the H2-O2 combustion reactions.** M. Rashidi (Arya Mehr, University of Technology, Teheran, Iran) and G. A. Karim (Calgary, University, Calgary, Alberta, Canada). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 9C-21 to 9C-36. 33 refs. Research supported by the Science Research Council.

A77-33407 # **A consideration of catalytic effects on Pt-Pt/Rh thermocouples in combustion systems involving hydrogen as a fuel.** G. A. Karim (Calgary, University, Calgary, Alberta, Canada), M. V. D'Souza (National Research Council, Div. of Building Research, Ottawa, Canada), S. L. Khanna (Saskatchewan, University, Saskatoon, Canada), and M. Rashidi (Arya Mehr University of Technology, Tehran, Iran). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 9C-37 to 9C-42. 8 refs.

Measurements of the temperature of combustion systems by thermocouples are often in error, caused primarily by the difference between the local temperature of the gas and the mean temperature actually attained by the thermocouple junction. These errors are discussed with reference to those which result from catalytic effects involving the widely used Pt-Pt/Rh thermocouples in combustion systems utilizing hydrogen as a fuel. It is suggested that sheathing the thermocouple junction in very thin quartz tubing offers the most effective preventative for these errors. M.L.

A77-33408 # **On the storage of hydrogen by use of cryo-adsorbents.** C. Carpetis and W. Peschka (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Energiewandlung und Elektrische Antriebe, Stuttgart, West Germany). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 9C-45 to 9C-54.

A future hydrogen economy would require an efficient storage system for large quantities of hydrogen. The use of adsorbent materials such as liquid hydrogen, activated carbon, or nickel silicate

is studied at cryogenic temperatures in the liquid nitrogen range and at pressures up to 60 bar. Hydrogen storage densities comparable to the density of liquid hydrogen are obtained. Storage efficiencies and energy consumption for systems using different adsorbents are estimated. Also discussed is the extent to which the storage efficiency could be increased by regenerative heat exchange. M.L.

A77-33409 # **Reciprocating pump for conversion of liquid hydrogen to high pressure gaseous hydrogen.** J. S. Meserole, Jr. and P. C. T. de Boer (Cornell University, Ithaca, N.Y.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 9C-55 to 9C-69. 20 refs. Research supported by the U.S. Department of Transportation.

The design, construction, and testing of a reciprocating pump for converting cryogenic liquid hydrogen stored at relatively low pressure to gas at high pressure is described. The pump can be driven by ambient or waste heat and does not require any electrical or mechanical power. A prototype was tested with liquid nitrogen. It is thought that the typical output pressure of 0.3 MPa absolute and the maximum output pressure of 1.3 MPa absolute can be increased to 7 MPa by modifying the pump. A thermodynamic analysis is presented of the expander cycle on which the device is based. M.L.

A77-33410 # **Hydrogen energy - Its potential promises and problems.** G. D. Sauter (California, University, Livermore, Calif.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 1C-5 to 1C-12. Contract No. W-7405-eng-48.

The prospects for developing the use of hydrogen as a secondary fuel are discussed. Topics considered include: progress in improving thermochemical and electrolytic production of hydrogen, transportation of hydrogen in pipelines, differences in the combustion of hydrogen and natural gas, environmental and safety concerns (leaks through gas-tight fittings, low ignition energy), and the capital outlay required for widespread use of hydrogen. It is suggested that hydrogen will be a significant factor in future energy technology, but that the expansion of its role will be gradual. M.L.

A77-33411 # **Analysis of a Delphi study on hydrogen.** P. Valette, L. Valette, and M. Siebker (S.C.I.E.N.C.E., Brussels, Belgium). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 1C-13 to 1C-26.

A questionnaire survey of energy experts on the future potential use of hydrogen in energy projects is reported. The survey relied on the Delphi method, which consists of iterative consultation with individual respondents, none of whom know the identity of other participants. In the second and third mailings of a series of three mailings, the respondent receives the original questionnaire along with information on the median and interquartile range of all previous responses, and is asked whether he would like to modify or justify his previous individual responses. In this survey, questions were asked concerning the extent of expected development of hydrogen production, transportation, storage, and consumption by 1985 and by 2000. The response data, which include the estimate that hydrogen would account for 5% of energy consumption by 2000, are presented. M.L.

A77-33412 # **ERDA's hydrogen programs.** A. R. Landgrebe (ERDA, Washington, D.C.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 1C-27 to 1C-43. 16 refs.

ERDA research projects concerning the production or use of hydrogen as a fuel are discussed. A steam-iron plant for producing hydrogen is described and research on water electrolytic, thermochemical, and photochemical methods of hydrogen production is reported. End-use applications of hydrogen which are being studied by ERDA include: load-leveling in utilities, electrical generation, substitution for natural gas, and automotive applications. It is suggested that the most likely use of hydrogen in the near future will be as a medium for delivering nuclear-derived energy as a supplement for natural gas. Environmental effects and the favorable features of hydrogen as a component of energy programs are summarized. M.L.

A77-33413 * # **The NASA Hydrogen Energy Systems Technology study - A summary.** E. A. Laumann (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 1C-45 to 1C-59. Contract No. NAS7-100.

This study is concerned with: hydrogen use, alternatives and comparisons, hydrogen production, factors affecting application, and technology requirements. Two scenarios for future use are explained. One is called the reference hydrogen use scenario and assumes continued historic uses of hydrogen along with additional use for coal gasification and liquefaction, consistent with the Ford technical fix baseline (1974) projection. The expanded scenario relies on the nuclear electric economy (1973) energy projection and assumes the addition of limited new uses such as experimental hydrogen-fueled aircraft, some mixing with natural gas, and energy storage by utilities. Current uses and supply of hydrogen are described, and the technological requirements for developing new methods of hydrogen production are discussed. M.L.

A77-33414 # **Technology impact assessment of the hydrogen economy concept - Key findings.** E. M. Dickson (Stanford Research Institute, Menlo Park, Calif.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 2C-5 to 2C-16. NSF-sponsored research.

A series of research and development goals with relevance for hydrogen economy studies are suggested. Methods of evaluating investment requirements during a transition to a hydrogen economy are discussed. The effects of a federal decision either to enhance or to diminish or to be neutral about the use of hydrogen are analyzed. A pro-hydrogen governmental policy might lead to the use of hydrogen for long-distance domestic commercial aviation, electric utility load-leveling, and nuclear steelmaking with hydrogen used for iron ore reduction. M.L.

A77-33415 # **Will the large-scale production of hydrogen be part of the energy problem or part of its solution.** G. D. Sauter (California, University, Livermore, Calif.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 2C-17 to 2C-32. 5 refs. Contract No. W-7405-eng-48.

The energy dynamics of nuclear reactors as a means of generating hydrogen are discussed since it is assumed that, at least initially, the large-scale production of hydrogen from water, either by electrolysis or thermochemical splitting, will rely on nuclear reactors as a primary energy source. The following questions are considered: what would be the energy cost of developing a given system; will it produce more energy than it costs, or will it be a net drain on the troubled energy economy; and given that the system will produce net energy, will the energy be produced in adequate amounts and in a timely fashion. The analysis of the impact of development by the year 2000 of the capacity to generate annually the amount of hydrogen which has the heat content of the natural gas consumed in the U.S. in 1970 suggests that nuclear reactors, rather than hydrogen, would be the energy storage mechanism. M.L.

A77-33416 # **The Greenland hydropower as a source of electrolytic hydrogen.** U. La Roche (Brown, Boveri et Cie. AG, Baden, Switzerland). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 2C-33 to 2C-42. 12 refs.

A preliminary assessment of the hydropower potential of Greenland is provided. In summer, ice moving towards the coast reaches a peripheral ablation zone where ablation occurs, producing both icebergs and water. Water in the peripheral ablation zone flows mostly through an icefree coastal zone which is about 400 to 800 m above sea level. Numerous natural lakes can be used for water storage. If a means could be found to lift water to the level of nunataks, which are mountains rising above the ice field, drops of 1000 to 2000 m above sea level would be available. The water supply could be increased by artificially decreasing the albedo. It is suggested that electrical energy produced by hydropower could be used to synthesize ammonia which could be transported by LNG tankers. Hydrogen would then be generated from the ammonia as needed. Energy cost estimates and estimates of recoverable hydropower are provided. M.L.

A77-33417 # **Hydrogen in the seaward advancement of industrial societies.** J. A. Hanson (Oceanic Institute, Waimanalo, Hawaii). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 2C-43 to 2C-54. 35 refs.

It is suggested that offshore urban industrial complexes be designed in conjunction with offshore production of hydrogen, which can be used as fuel. Commercial ocean development of cities is discussed, with attention directed to Ecofisk City, the North Sea petroleum base. Some offshore projects that could use hydrogen as an energy source, and thereby obviate the cost of transporting hydrogen to land, include waste recycling, open sea mariculture, and auxiliary power experiments involving waves, solar radiation, or wind. M.L.

A77-33418 * # **Hydrogen use projections and supply options.** R. Manvi and T. Fujita (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 3C-3 to 3C-26. Contract No. NAS7-100.

Two projections of future hydrogen demand, based on the Ford technical fix and the Westinghouse nuclear electric economy energy supply and demand scenarios, are analyzed. It is suggested that hydrogen use will increase during the remainder of this century by at least a factor of five, and perhaps by a factor of twenty. Primary energy sources for producing hydrogen are discussed in terms of the transition from low to high demand for hydrogen. M.L.

A77-33419 # **Economics of nuclear-electrolytic hydrogen.** S. Kakac (Middle East Technical University, Ankara, Turkey) and T. N. Veziroglu (Miami, University, Coral Gables, Fla.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 3C-27 to 3C-45. 14 refs.

An economic analysis of the future role of nuclear energy is offered. The use of electrolytically produced hydrogen would, it is suggested, provide an economical means of storing and transmitting energy generated by nuclear power plants. Hydrogen production and the economics of nuclear power plants in comparison with coal plants are discussed. M.L.

A77-33420 # **Hydrogen in the energy system of the Netherlands.** A. J. Bogers and W. van Deelen (Centrale Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek, Apeldoorn, Netherlands). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 3C-47 to 3C-65.

An analysis of the Dutch energy system and of possible shifts away from reliance on imported oil is provided. The main drawback of relying exclusively on electricity produced by nuclear energy or wind energy is that this electricity cannot be stored in large quantities. From the viewpoint of capital costs, a system based on both electricity and hydrogen as the main energy carriers is considered preferrable to a system based on either electricity or hydrogen alone. Hydrogen could be stored in small- and medium-sized natural gas wells after the natural gas has been removed, and existing natural gas lines could be used for transfer of hydrogen. In this analysis, electrolytic methods of hydrogen production are preferred over thermochemical methods for reasons of cost, safety, reliability, and purity of product. Modes of hydrogen utilization are discussed. A timetable for introducing hydrogen into the energy system is presented. M.L.

A77-33421 # **A simplified equilibrium model of the U.S. energy-economic system and its use in comparing alternatives.** H. J. Plass, Jr. (Miami, University, Coral Gables, Fla.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 3C-75 to 3C-98. 11 refs.

A simplified model of the U.S. energy-economic system is developed using published data on energy flows, labor employed, and dollar flows. The energy system, usually divided into the sectors in industry, electric power, residential-commercial, and transportation is restructured into a three-sector model including extraction and production of energy resources, production of goods and services, and consumption of fuels, goods and services. Effects on fuel used, employment, and standard of living of various alternatives are examined, including high prices of imported fuel, technological improvements, solar energy for space and water heating, and hydrogen fuel for transportation. (Author)

A77-33422 # **Possible pollution and cost analysis from wide use of hydrogen fuel in transportation.** S. P. Chakravarty (Southampton University, Southampton, England) and K. S. Varde (Michigan, University, Dearborn, Mich.). In: World Hydrogen Energy Conference, 1st, Miami Beach, Fla., March 1-3, 1976, Proceedings. Volume 3. Coral Gables, Fla., University of Miami; New York, Pergamon Press, 1976, p. 4C-5 to 4C-17. 19 refs. Research supported by the University of Michigan.

Over the past few years considerable effort has been directed at developing alternate forms of energy that could be easily adapted to surface transportation. One of such fuels that has received wide attention is hydrogen. The potential of hydrogen fuel for internal combustion engines is analyzed and compared with gasoline fuel from the standpoint of pollution and engine efficiency. A sequential approach is outlined which provides a means to predict cost benefits of using hydrogen. Hydrogen engine can be operated around an equivalence ratio of 0.50 with low nitric oxide emission and high efficiency. S.D.

A77-33430 # **Use of transparent heat reflecting coatings in solar energy converters (Ispol'zovanie prozrachnykh teplootrazhaiushchikh pokrytii v preobrazovateliakh solnechnoi energii).** M. M. Koltun and Sh. A. Faiziev (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 1, 1977, p. 28-31. 11 refs. In Russian.

The paper describes the optical characteristics (integrated transmission coefficient and integrated coefficient of thermal emission) of ZnS-Ag-ZnS coatings on substrates of glass and polymeric film. The coating finds application in the annealing of the

radiation defects of silicon solar cells and as a heat-reflecting layer in high-voltage photoelectric converters. B.J.

A77-33431 # **Combination of focusing concentrators and focusing lenses (Sochetanie fokonov i foklinov s priemnikami izlucheniia).** V. K. Baranov. *Geliotekhnika,* no. 1, 1977, p. 32-37. 8 refs. In Russian.

The paper describes solar collectors which operate in conjunction with focusing concentrators and focusing lenses. It is shown that binary systems consisting of focusing concentrators and lenses connected by small apertures can be used to reduce the angle of exit of rays from the system. The use of this binary system reduces the geometrical coefficient of concentration, but also reduces the angle of exit of rays from the system. B.J.

A77-33432 # **The use of lasers for the inspection of heliotechnical reflectors (Primenenie lazerov dlia kontrolia geliotekhnicheskikh otrazhatelei).** R. A. Zakhidov, P. A. Panov, and V. N. Sokolov (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe i Tekhnologicheskoe Biuro Nauchnogo Priborostroeniia, Uzbek SSR). *Geliotekhnika,* no. 1, 1977, p. 38-41. 7 refs. In Russian.

The paper describes the application of laser beam diagnostics to the inspection of the accuracy of a solar reflecting surface. The system uses the LG-75 helium-neon laser at 6328 A, with an output power of 25 mW; the collimator has amplifications of 30 and 60 times. The configuration of focal spots of separate facets of a paraboloidal collector inspected by the laser system is presented. B.J.

A77-33433 # **Paraboloid-hyperboloid concentrating systems and their accuracy (Paraboloid-giperboloidnye kontsentriruiushchie sistemy i ikh tochnost').** R. A. Zakhidov and A. A. Vainer (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotekhnika,* no. 1, 1977, p. 42-49. 10 refs. In Russian.

A general method is presented for calculating the distribution of the radiant vector in paraboloid-hyperboloid solar concentrating systems. An investigation of the accuracy characteristics of systems with concave hyperboloid surfaces establishes that the accuracy of such systems is almost totally determined by the accuracy of the primary mirror. B.J.

A77-33434 # **Combined cycles in single circuit solar refrigerating systems (O sopriazhennykh tsiklakh odnokonturnykh solnechnykh energokholodil'nykh ustanovok).** V. A. Grilikhes, V. S. Evseev, and V. V. Chikovani. *Geliotekhnika,* no. 1, 1977, p. 50-58. 17 refs. In Russian.

The possibility of realizing more than one thermodynamic cycle in single circuit thermal energy systems is discussed from the standpoints of topology and thermodynamics. Attention is given to the general characteristics of using combined cycles in solar refrigerating systems with radiant energy concentrators and radiative heat transfer into the ambient medium. B.J.

A77-33435 # **Statistical investigation of the operational efficiency of solar and evaporative cooling devices in Turkmenian conditions (Statisticheskoe issledovanie effektivnosti raboty solnechnykh i isparitel'nykh okhladitelei v usloviiakh Turkmenii).** A. Rakhmanov, A. Khanduryev, A. Kakabaev, M. Goshdzhanov, and M. Annanazarov (Akademiia Nauk Turkmenskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). *Geliotekhnika,* no. 1, 1977, p. 59-64. 5 refs. In Russian.

A77-33445 **Applied solar energy: An introduction /2nd edition/.** A. B. Meinel and M. P. Meinel (Arizona, University, Tucson, Ariz.). Research supported by the Mulcahy Foundation, Helio Associates Corporate Research Funds, and NSF; NSF Grants No. GI-30022; No. GI-36731; No. GI-41895. Reading, Mass., Addison-Wesley Publishing Co., Inc., 1977. 667 p. 177 refs. $17.95.

After a brief review of the history of solar energy applications, the book considers the energy resource, giving attention to solar flux and weather data and solar energy availability. The optics of solar collection is examined in detail with consideration of luminance, refractive optics, mirror optics, fixed-mirror collectors, and optical surfaces. Absorption, transfer and storage are discussed and such applications as thermodynamic utilization cycles, and direct conversion to electricity are examined. B.J.

A77-33496 **The future outlook for U.S. electricity supply and demand.** M. L. Baughman (Texas, University, Austin, Tex.) and P. L. Joskow (MIT, Cambridge, Mass.). *IEEE, Proceedings,* vol. 65, Apr. 1977, p. 549-561. 28 refs. Research supported by the Ford Foundation; NSF Grant No. SIA-73-07871A02.

In this paper we assess the prospects of the United States' electric utility industry from now to 1995. The methodology employed is a mathematical model of electricity supply and demand that has been constructed to analyze the future behavior of the industry in response to changing resource and regulatory parameters. A set of supply and demand projections derived from the model is compared and contrasted with other recently published and publicly available forecasts. Among the uncertainties in the future outlook discussed in this paper are the absence of a clear ability to attract the capital necessary to finance orderly expansion, the difficulties in closing the fuel cycle, and the continuing decline in average-to-peak load ratios. (Author)

A77-33522 **Summary of 1976 geothermal drilling - Western United States.** J. L. Smith, C. F. Isselhardt, and J. S. Matlick (Republic Geothermal, Inc., Santa Fe Springs, Calif.). *Geothermal Energy,* vol. 5, May 1977, p. 8, 9, 11-13, 15-17.

A77-33523 **Present status of resources development.** L. J. P. Muffler (U.S. Geological Survey, Menlo Park, Calif.). *Geothermal Energy,* vol. 5, May 1977, p. 18-30. 24 refs.

Geoheat exploration and exploitation in recent years is summarized on a world scale. The survey includes separate discussions of geoheat resources and development in: Italy, U.S.A., Japan, Iceland, Mexico, Central America and Caribbean, South America, Turkey, New Zealand, East Africa, Indonesia, India, Eastern Europe and USSR, Philippines and Taiwan, and Azores. Discrepancies between data on fields discovered and actual commercial exploitation, and between electrical capacity data and direct geoheat utilization, are indicated. Information is provided on sites, field capacities, depths of drillings, geoheat formations and field development policies. Sites are indicated on regional maps. R.D.V.

A77-33524 **An update of world geothermal energy development.** T. Meidav, S. Sanyal, and G. Facca (Geonomics, Inc., Berkeley, Calif.). *Geothermal Energy,* vol. 5, May 1977, p. 30-34.

The current status of geothermal development in a number of countries is summarized. Figures on current and expected geothermal electrical power capacity made available by governmental agencies or research institutions. Brief summaries (updated as of Dec. 1976) are presented on: Costa Rica, Guatemala, Honduras, Nicaragua, Panama, Argentina, Brazil, Portugal (Azores), Spain, Sweden, Britain, Yugoslavia, Israel, Jordan, and Fiji. R.D.V.

A77-33525 **Potential land subsidence at geothermal development sites.** E. J. Finnemore. *Geothermal Energy,* vol. 5, May 1977, p. 35-39. 5 refs. NSF Grant No. AER-75-17298.

Mechanisms and results of the impact of geothermal subsidence on various local surface features and structures are discussed. Compaction and fracture closing are considered the most likely contributors to geothermal subsidence. Characteristics suitable as indicators of subsidence potential are identified from site geology, fluid, reservoir, and material parameters. Available rudimentary geothermal subsidence models are mentioned. Injection is acknowl-

edged the best available subsidence control measure, but shortages of injection fluid are noted. Joint use of analogy and analysis for subsidence predictions is recommended. R.D.V.

A77-33526 # **Studies on the energy system of Hokkaido. I - First attempt: Model-I. II - Various data and their basis. III - Simulations by Model-I.** J. Hasegawa, K.-I. Nishiya, K. Murai, and Y. Satoh. *Hokkaido University, Faculty of Engineering, Bulletin,* vol. 83, Mar. 1977, p. 89-99, 101-111, 113-122. 24 refs. In Japanese, with abstract in English.

The three-part article takes up the Model-I developed by the authors for analysis and optimization of the Hokkaido area energy system, interrelations of the Hokkaido energy system and other regional systems (economic, environmental, and social aspects), and presents numerical results derived from Model-I simulation. Model-I is a static linear-programming model entertaining 192 variables, 46 equality constraints, and 28 inequality constraints, with about 6% density. The model leaves dynamic behavior of the energy system out of account. All data reported are referable to 1974 (calendar year). Estimates of supplies and demands of energy sources, conversion efficiencies, costs, and pollutant emissions (SOx, NOx, dust) are reported. R.D.V.

A77-33529 Recovering metal from trash. E. Schloemann (Raytheon Co., Research Div., Waltham, Mass.). *Electronic Progress,* vol. 19, Spring 1977, p. 20-26. 8 refs.

Equipment used to recover metal in a resource recovery plant is described. An electromagnetic metal separator has a long ramp in which permanent magnetic strips of alternating polarity are embedded at an angle of approximately 45 deg to the ramp axis. Under the influence of the electric eddy currents induced in magnetic particles moving through the magnetic field, the metallic particles are deflected from the stream of nonmetallic particles and are separately collected. A self-cleaning metal separator was designed to recover composite products containing both metal and nonmetal. These objects with residual magnetism tended to stick to the surface of the electromagnetic separator. In the self-cleaning separator, the objects stick to a steel sheet which moves sideways, which permits separation and recovery. A rotary-drum metal separator is described for which the recovery efficiency and the grade of the recovered product is high but the throughput capacity low. It is suggested that resource recovery plants of the future will operate several ramp metal separators as a first stage and a large rotary-drum metal separator as a second stage for cleaning up the middling fraction of the primary stage. M.L.

A77-33544 Nonisothermal hydrogen-induced desulfurization of coal (Nichtisotherme Entschwefelung von Steinkohlen mit Wasserstoff). H. Baumann, J. Klein, and H. Jüntgen (Bergbau-Forschung GmbH, Essen, West Germany). *Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoff-Chemie,* vol. 30, Apr. 1977, p. 159-164. 29 refs. In German. Research supported by the Bundesministerium für Wirtschaft.

The temperature dependence of sulfur removal from coal in the form of H2S, via a hydrodesulfurization process using nonisothermal experimental techniques, is examined. The effect of the partial pressure of hydrogen and of coal rank on desulfurization is studied. Low-rank coals release the bulk of their organic sulfur at temperatures below 500 C, even in the absence of hydrogen, but anthracites give up organic sulfur above 600 C via reactions with hydrogen. A reaction setting in at 800 C binds the sulfur to the coal, with hydrodesulfurization rendered difficult when the temperature is subsequently raised to 1000 C. Kinetic and thermodynamic data on reactions of pyrite and H2, and FeS and H2, are reported. R.D.V.

A77-33545 Emissions from compressor stations (Emissionen von Verdichterstationen). U. W. Binder, H. Ackermann, and K. Seubert (Ruhrgas AG, Essen, West Germany). *Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoff-Chemie,* vol. 30, Apr. 1977, p. 165-172. 8 refs. In German.

Emphasis is placed on noise emissions and vibrations emanating from compressor stations, since emission of pollutants is considered less of a general problem in the case of compressor stations (particularly if natural gas is employed as fuel). Arrangements for damping and suppression of noise and vibration are discussed and illustrated. R.D.V.

A77-33596 Evaluating a combined wind power/energy storage system. W. H. Coste (Massachusetts Audubon Society, Mass.) and M. Lotker (Northeast Utilities Service Co., Hartford, Conn.). *Power Engineering,* vol. 81, May 1977, p. 48-51.

A methodology for analyzing the economic costs and benefits of a system which combines energy storage with wind-driven power generators is presented. The advantages of such a system are that, with sufficient storage, energy could be delivered on demand with minimal environmental impact and without depleting the source of energy. A computer model has been developed to optimize the amount of storage and generating capacity for a particular location, and has been applied to the study of a site at Waterford, Conn. In general, the model suggests that combined wind power and storage systems are capable of producing reliable, albeit costly, power at all capacity factors with a reasonable availability. Sites with average wind speed in excess of 15 mph might be required for economic viability. M.L.

A77-33598 The chemical conversion of sunlight. M. S. Wrighton (MIT, Cambridge, Mass.). *Technology Review,* vol. 79, May 1977, p. 30-37. 10 refs.

Photochemical conversion is explored as a possible solution to the problem of storage of intermittently available solar energy. The advantages of photoelectrochemical cells utilizing semiconductor electrodes immersed in liquid electrolytes are examined, and cell efficiencies are discussed. Thermodynamic stability of photoinduced electrolysis, band bending as a barrier to charge recombination, charge separation, and the search for photoassistance agents to absorb sunlight by photoelectrochemical means are discussed. Controlling factors for interfacial electron transfer rates are seen as a major research target. Applications in large-scale power stations and transportation system power plants are envisaged. R.D.V.

A77-33600 The politics of urban transportation innovation. A. Altshuler (MIT, Cambridge, Mass.). *Technology Review,* vol. 79, May 1977, p. 50-58. 8 refs. U.S. Department of Transportation Contract No. OS-50240.

Underlying mechanisms of political responses (by the general public and by elected officials at various levels) to funding of highway systems and mass transit systems, and changes in large-scale urban traffic patterns, are explored. Reasons for the recent political attractiveness of mass transit programs, the likely proportions of increase in riders per dollar spent on mass transit and likely tangible results re pollution and fuel use, and limitations on the effectiveness of innovative alternatives (carpooling, vanpooling, demand-responsive urban transit, individual auto travel disincentives), are discussed, and mass transit prospects by rail and by bus are evaluated. Political palatability of measures is tied to who pays the bill (industry, public) and who shoulders the blame (industry, elected officials). The best outlook is seen in automotive technological improvements (emissions, fuel efficiency, safety) and in rationalized traffic management. R.D.V.

A77-33616 Composite technology - The boom is under way. D. J. Hoffstedt (Boeing Vertol Co., Philadelphia, Pa.). *Vertiflite,* vol. 23, Mar.-Apr. 1977, p. 6. 7.

The state of the art in rotorcraft composite materials and barriers to acceptance of those materials in industry are assessed. Weight-saving goals cost competitiveness, and research/design requirements are considered. Development status of composites for various rotorcraft subsystems and components are characterized briefly: rotor blades, rotor hubs, landing gear, tail rotor, tail boom,

horizontal stabilizer, secondary structure, tail rotor drive shafting, transmission cases, primary airframe, flight control elements, engine components. R.D.V.

A77-33708 **Laser anemometry in high velocity, high temperature boundary layers.** S. A. Self (Stanford University, Stanford, Calif.). In: Combustion measurements: Modern techniques and instrumentation; Proceedings of the SQUID Workshop, Purdue University, West Lafayette, Ind., May 22, 23, 1975. New York, Academic Press, Inc.; Washington, D.C., Hemisphere Publishing Corp., 1976, p. 103-107.

A laser anemometer has been developed to measure the profiles of average velocity and turbulence in the electrode wall boundary layers of the Stanford 2 MW and 8 MW MHD systems. The experiments called for measurements of high spatial resolution (0.01 mm) close to the electrode wall in hot, turbulent, high velocity gases in which there were negligible scattering centers naturally present. B.J.

A77-33710 **Boundary layer measurements of temperature and electron number density profiles in a combustion MHD generator.** J. W. Daily and C. H. Kruger (Stanford University, Stanford, Calif.). In: Combustion measurements: Modern techniques and instrumentation; Proceedings of the SQUID Workshop, Purdue University, West Lafayette, Ind., May 22, 23, 1975. New York, Academic Press, Inc.; Washington, D.C., Hemisphere Publishing Corp., 1976, p. 119-126. U.S. Department of the Interior Contract No. DI-14-32-001-1227; NSF Grants No. ENG-73-04116A01; No. AER-72-03487; Contract No. F33615-72-C-1088.

Spectroscopy was applied to boundary layer measurements in an MHD generator. The gas temperature was measured using the sodium D line wing reversal method. The electron density was measured using the absolute and relative intensities of nonresonant potassium lines originating from high lying electronic levels which are in collisional equilibrium with the free electrons. B.J.

A77-33755 **Economics of alternative energy sources.** M. Ryle (Cambridge University, Cambridge, England). *Nature*, vol. 267, May 12, 1977, p. 111-117. 29 refs.

Partly because of large fluctuations in demand, the replacement of oil and gas fuels currently used to heat buildings in the UK by nuclear-generated electricity would seem to require the construction of about 250 GW of additional capacity by the end of the century, which does not seem feasible. If short-term (150-hour) energy storage in the form of heat is developed to a sufficient extent, the generating capacity required to fulfill peak demand could be reduced by half. With the same amount of short-term storage, however, other sources of energy, obtained from wind, wave, or tidal power, might become viable alternatives. It is suggested that the value of North Sea oil and gas to the chemical industry should lead, for economic reasons, to an early reduction in their consumption as fuel. M.L.

A77-33799 **A minority carrier MIS solar cell.** D. L. Pulfrey. *Solid-State Electronics*, vol. 20, May 1977, p. 455-457. 15 refs.

MIS solar cells are described which exhibit high fill factors and open-circuit voltages and which have dark forward-bias I-V characteristics of a double exponential form. Insulator formation was achieved by low-temperature oxidation in air, and an optimum insulator thickness of 12-15 A was observed. The device properties suggest that the diodes may be operating in a recently described nonequilibrium minority-carrier tunnel mode. (Author)

A77-33838 # **Turbulent flow structures and recirculation patterns associated with cyclone combustors and their effect on flame stabilisation.** A. C. Styles, N. Syred, and S. E. Najim (University College, Cardiff, Wales). In: Symposium on Turbulent Shear Flows, University Park, Pa., April 18-20, 1977, Proceedings. Volume 1. University Park, Pa., Pennsylvania State University, 1977, p. 7.25-7.34. 22 refs. Research supported by the Science Research Council.

This paper examines in detail the combustion aerodynamics and burning behavior of a cyclone combustor with the flame stabilized internally, close to the walls by the combined processes of aerodynamic recirculation of heat and active chemical species, and extremely long residence times and some heat re-radiation from the walls. This mode of burning has applications in burning either poor quality fuels or weak mixtures of rich fuels such as natural gas and as a part of a multi-stage, low pollution combustor. This work shows that the main flow pattern consists of a swirling flow which slowly descends down the device, is deflected radially inwards by the base and then slowly ascends up the device. Between these two layers a long thin annular recirculation zone is formed on whose boundary the flame is stabilized. Measurements of species concentration, mean temperature and velocity are presented. (Author)

A77-33967 **Sun power: An introduction to the applications of solar energy.** J. C. McVeigh (Brighton Polytechnic, Brighton, England). Oxford and New York, Pergamon Press, 1977. 217 p. 411 refs. $10.50.

A geographical survey of current solar energy activities and applications is provided and the characteristics of solar radiation are examined, taking into account global direct and diffuse radiation, spectral distribution, radiation measuring instruments, and data from a radiation measurement network. Water and air heating applications *are considered along with space heating applications, thermal power* and other thermal applications, methods of economic analysis, wind power, some practical heating applications, photovoltaic cells, biological conversion systems, and photochemistry. G.R.

A77-34039 **Conductivity of seeded combustion products of acetylene systems.** M. S. Sodha, B. K. Sawhney, A. Chandra, S. Q. Hussain, S. C. Kaushik, R. P. Sharma, and A. K. Ghatak (Indian Institute of Technology, New Delhi, India). *Combustion and Flame*, vol. 28, no. 3, 1977, p. 295-300. 7 refs. Navy-NSF-supported research.

In this paper, the variation of the electrical conductivity of seeded combustion products of an air-acetylene system (seeded with K2CO3) with temperature and seeding ratio has been investigated experimentally and the results are found to be in reasonable agreement with theory. The analytical evaluation takes into account the effect of the hydroxyl radical on the electron density, and the energy dependence of the electron collision frequency. A seeded air-acetylene system is found to yield conductivities of interest in MHD power generation. Optimum seeding ratios, corresponding to maximum conductivity, have been evaluated for air-acetylene and oxyacetylene flames; they are found to be very large as compared to *the seeding ratios achieved in the experiments.* (Author)

A77-34103 **Factors which maximize the efficiency of Cr-p-Si Schottky /MIS/ solar cells.** W. A. Anderson, S. M. Vernon, A. E. Delahoy, J. K. Kim, and P. Mathe (Rutgers University, New Brunswick, N.J.). *Journal of Vacuum Science and Technology*, vol. 13, Nov.-Dec. 1976, p. 1158-1161. 7 refs. Research supported by the Exxon Enterprises and NSF.

Processing steps used in fabricating silicon Schottky solar cells were evaluated to optimize energy conversion efficiency. Factors such as wafer resistivity and orientation, etching, oxide growth, heat treatment, deposition technique, and grid design are included in the study. The proper heat treatment and metal deposition rate are most crucial in achieving a high open-circuit voltage. The process has produced a solar cell with Voc = 0.55 V, fill factor of 0.71, and 8.6% AM1 efficiency with a potential improvement to 12.5%. (Author)

A77-34112 **Photovoltaic systems.** M. B. Prince (ERDA, Div. of Solar Energy, Washington, D.C.). *Signal*, vol. 31, May-June 1977, p. 83-86. ERDA-DOD-supported research.

Goals, strategy, and plans of military research on photovoltaic solar energy systems (National Photovoltaic Program) are reviewed. Military applications are viewed as offering early cost-effective uses of solar photovoltaic energy conversion systems. Development of reliable low-cost photovoltaic systems, overcoming high initial cost at low array production levels, demonstration of the feasibility of thin-film technology, development of performance standards, and dealing with environment and legal problems are encompassed in the program. Attention is given to development of large-area silicon sheet technology, development of solar concentrators, marketing studies, sensors and monitors for remote military surveillance systems, and water energy storage subsystems. R.D.V.

A77-34113 Solar electricity for military applications. T. Blumenstock and M. A. Goold (Solarex Corp., Rockville, Md.). *Signal*, vol. 31, May-June 1977, p. 88-90, 92, 94.

Modular arrays of panels of photovoltaic solar cells for low-cost solar power are described. Reliability, mechanical design and mountings, temperature behavior, charging capability and overcharging protection, and reduction of costs from $500/W to $15/W are discussed. Panels feature 5 x 5 or 6 x 3 interconnected photovoltaic cells mounted on fiberglass board and encapsulated in transparent stabilized silicone, with no exposed metal terminals. Plexiglas, lexan, or glass covers are also available. Recommended military applications include: mobile communications, radio/telephone repeaters, tactical radio battery chargers, navigation aids, water purification and pumping, remote security and surveillance (seismic, magnetic, acoustic, IR), data collection platforms (environmental, hydrological, geological), railroad signaling, and impressed current cathodic protection. R.D.V.

A77-34114 Methanol, past, present, and speculation on the future. A. B. Stiles (Delaware, University, Newark, Del.). *AIChE Journal*, vol. 23, May 1977, p. 362-375. 83 refs.

Methanol is overviewed from the standpoint of history: how the history relates to the present and how it could relate to the future. The overview includes ingredients (fuels, catalysts, etc.), synthesis gas generating procedures, processing techniques, and equipment and other considerations for the present and the near and more distant term future. (Author)

A77-34117 Photovoltaic properties of GaSe and InSe junctions. A. Segura, J. M. Besson, A. Chevy, and M. S. Martin (Paris VI, Université, Paris, France). *(International Conference on Layered Semiconductors and Metals, Bari, Italy, Sept. 6-10, 1976.) Nuovo Cimento, Sezione B*, vol. 38B, Apr. 11, 1977, p. 345-351.

Photovoltaic and photoelectronic properties of GaSe and InSe metal-semiconductor contacts are reported. The shape of the spectra, at room temperature, can be interpreted with reasonable values for diffusion length and junction depth. The variation of the spectra with pressure in GaSe and the shape of the low-energy tail in InSe are in concordance with the indirect nature of the lower energy gaps in both compounds. A comparison of these materials with other semiconductors for photovoltaic conversion purposes is given. (Author)

A77-34122 Development of low-power gas turbines with regenerative heat exchangers at MTU. I (Die Entwicklung von Gasturbinen kleiner Leistung mit regenerativen Wärmetauschern in der MTU. I). W. Heilmann and K. Hagemeister. *Motortechnische Zeitschrift*, vol. 38, May 1977, p. 209-212, 215, 216, 219, 220. 11 refs. In German.

The paper gives an account of work carried out toward the development of small regerative gas turbines intended to provide competition with Diesel engines for application in land vehicles. Thermodynamic studies leading to a choice of thermodynamic cycle are summarized, and the design of a basic configuration is described. The results of optimization studies for individual components are presented. P.T.H.

A77-34221 Influence of the spatial inhomogeneity of the field and amplifying medium on the energy characteristics of a gas laser. P. V. Korokenko, A. I. Odintsov, and N. E. Sarkarov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *(Kvantovaia Elektronika* /Moscow/, vol. 4, Jan. 1977, p. 166-168.) *Soviet Journal of Quantum Electronics*, vol. 7, Jan. 1977, p. 92, 93. 9 refs. Translation.

Allowance is made for the influence of the spatial inhomogeneity of the active medium and radiation field on the output power of a laser in the form of homogeneously and inhomogeneously broadened TEM-00 mode lines. A calculation carried out subject to this allowance makes it possible to determine the optimal values of the transmission coefficients of the resonator mirrors and of the degree of occupancy of the active medium by the laser field. It is shown that the inhomogeneities of the active medium and field reduce the efficiency of energy conversion. The calculations are supported by the results of an experimental test carried out on an He-Ne-laser (at a wavelength of 632.8 nm). (Author)

A77-34298 # Performance optimization of an air-to-air missile design. J. Eichler (Negev, University, Beersheba, Israel). *Journal of Spacecraft and Rockets*, vol. 14, June 1977, p. 376, 377.

The paper describes a merit function for air-to-air missile designs which includes the salient design features and is based on performance, as evidenced by the capability to achieve a hit against a maneuvering target from a large number of different launch conditions. The problem is quantified by selecting 5 angles of line of sight (LOS) radii, 3 directions of launch for each LOS radius, and two types of maneuvering targets, thereby giving a 30-point quantification for the measure of missile performance. The merit function is calculated by finding for each case the minimum radius of launch that results in a hit. The merit function together with a Davidson variable metric conjugate gradient optimization technique is used to find an optimum set of design variables of a fictitious missile design. P.T.H.

A77-34306 'Free' and renewable energy sources. C. E. Wise. *Machine Design*, vol. 49, May 26, 1977, p. 22-24, 26-28.

Wind, solar, geothermal, ocean, and bioconversion energy systems are discussed. The ERDA 1978 budget request for energy research is examined, and estimates of the future contribution of different modes of energy generation are provided. Bioconversion projects considered involve wood and wood scraps, alcohol fermentation, agricultural wastes, and marine crops. It is suggested that energy options be assessed so that appropriate research programs can be organized. M.L.

A77-34366 High-efficiency and high-peak-power InP transferred-electron oscillators. J. Mun (Standard Telecommunication Laboratories, Ltd., Harlow, Essex, England). *Electronics Letters*, vol. 13, May 12, 1977, p. 275, 276. 6 refs. Research supported by the Ministry of Defence (Procurement Executive).

It has been demonstrated that a current-limiting cathode contact can be used to improve the performance of relatively thick vapour epitaxial InP transferred-electron devices. A peak power of 120 W with 18% efficiency at 5 GHz has been obtained from 34 micron thick active-layer devices with silver-tin-alloy metal contacts. (Author)

A77-34428 Mercury emissions from geothermal power plants. D. E. Robertson, E. A. Crecelius, J. S. Fruchter, and J. D. Ludwick (Battelle Pacific Northwest Laboratories, Richland, Wash.). *Science*, vol. 196, June 3, 1977, p. 1094-1097. 23 refs. NSF Grant No. 75-14714.

Geothermal steam used for power production contains significant quantities of volatile mercury. Much of this mercury escapes to the atmosphere as elemental mercury vapor in cooling tower exhausts. Mercury emissions from geothermal power plants, on a per megawatt (electric) basis, are comparable to releases from coal-fired power plants. (Author)

A77-34429 **Stable semiconductor liquid junction cell with 9 percent solar-to-electrical conversion efficiency.** K. C. Chang, A. Heller, B. Schwartz, S. Menezes, and B. Miller (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). *Science*, vol. 196, June 3, 1977, p. 1097-1099. 11 refs.

The semiconductor liquid junction cell n-GaAs/0.8M K2Se-0.1M K2Se2-1M KOH/C has been shown to attain 9 percent photovoltaic power conversion efficiency in sunlight. Accelerated tests under 3100 K light sources of several solar intensities indicate very low photocorrosion currents and high output stability. (Author)

A77-34449 **Energy analysis and the coupling of man and estuaries.** H. T. Odum, W. Kemp, M. Sell, M. Lehman (Florida, University, Gainesville, Fla.), and W. Boynton (Maryland, University, Prince Frederick, Md.). *Environmental Management*, vol. 1, no. 4, 1977, p. 297-315. 37 refs.

Four procedures for coastal planning are proposed. These are: (1) calculation of investment ratio in units of equal quality to determine which projects are economic in a broad sense, (2) development of energy signatures for coastal ecosystems, (3) determination of which interface ecosystems develop the best energy flows, and (4) development of regional models that include the main features of human and natural ecosystems. B.J.

A77-34561 **Infrared extinction spectra of some common liquid aerosols.** H. R. Carlon, D. H. Anderson, M. E. Milham, T. L. Tarnove, R. H. Frickel, and I. Sindoni (U.S. Army, Edgewood Arsenal, Aberdeen Proving Ground, Md.). *Applied Optics*, vol. 16, June 1977, p. 1598-1605. 7 refs.

Infrared extinction spectra in the 3-5 micron and 7-13 micron atmospheric window regions were obtained for smokes of petroleum oil, sulfuric acid, and phosphoric acid of varying droplet concentration and for water fogs. Spectra were also obtained at 0.36-2.35 micron for petroleum oil and sulfuric acid smokes. Experimental results were compared, for sulfuric acid and water aerosols, to calculated values obtained from the Mie theory. When absorbing smoke droplets are small compared to wavelength, very useful approximations apply, and droplet clouds may be spectrally simulated by thin liquid films. In such cases, the imaginary component of refractive index may be approximated directly from aerosol spectra. At 12.5-micron wavelength, water fog extinction is nearly independent of droplet size distribution, suggesting a simple scheme for measurement of total liquid water content of an optical path. (Author)

A77-34629 **Automotive sulfate emissions.** *Automotive Engineering*, vol. 85, June 1977, p. 26-31.

A baseline study of sulfate emissions from a variety of automotive vehicles was performed. The five categories investigated were current production noncatalyst vehicles; current production or prototype catalyst vehicles; advanced noncatalyst vehicles using stratified charge, diesel, lean reactor, lean burn, or rotary engines; advanced catalyst vehicles using three-way catalyst, dual catalyst, start catalyst, or oxidation catalyst with modulated air injection; and fleet vehicles. Noncatalyst vehicles all showed low level of sulfate emissions. Oxidation catalyst cars had significantly higher sulfate emission rates than either current or prototype noncatalyst cars. In general, sulfate emission rates were found to increase with decreasing HC, CO, and NOx emission levels. Other results are discussed in detail. M.L.

A77-34630 **Volkswagen develops a diesel.** *Automotive Engineering*, vol. 85, June 1977, p. 62-68.

A diesel engine designed for use in a passenger automobile is described. Fuel, performance, emissions, and manufacturing cost characteristics are considered. Different forms of diesel combustion chamber geometries are discussed. Design elements are analyzed in detail. Diesels offer greater fuel economy, reduced maintenance, and increased durability, although they are more expensive to manufacture and have less desirable cold start and idle behavior than conventional gasoline engines. Diesels generate low amounts of HC and CO but, because of high combustion temperatures, diesels might have difficulty meeting the proposed 0.4 g/mi NOx standard, although they satisfy current emissions requirements. M.L.

A77-34642 **Cut energy costs: A guide for buying and plant operation (Energiekosten senken: Ein Leitfaden für Einkauf und Betrieb).** Edited by K. Deparade. Gräfelfing, West Germany, Technischer Verlag Resch, 1977. 178 p. In German. $12.50.

This book is a collection of papers examining the energy-economical aspects of plant operation, with numerous suggestions being made for procedures which reduce energy losses in an industrial process. Topics discussed include electric power supply contracts and special price controls, energy cost reduction by maximum monitoring and maximum load optimization, electricity cost reduction by reactive current compensation, natural gas purchasing contracts and features of natural gas supply, and energy saving by heat insulation. P.T.H.

A77-34895 **Effects of nitrogen fertilizers and combustion on the stratospheric ozone layer.** P. J. Crutzen (National Center for Atmospheric Research, Boulder, Colo.) and D. H. Ehhalt (Kernforschungsanlage Jülich GmbH, Jülich; Köln, Universität, Cologne, West Germany). *Ambio*, vol. 6, no. 2-3, 1977, p. 112-117. 62 refs.

It is suggested that increased use of fixed nitrogen as fertilizer might reduce by a few percent the amount of ozone in the earth's atmosphere by the early years of the 21st century, and that this reduction might reach 10% by the end of the century. Emissions of N2O from coal combustion are also considered likely to contribute significantly to this problem. Ozone reactions and N2O measurement techniques are reviewed, and data on the vertical distribution of N2O and ozone are presented. The sources of nitrogen oxides are discussed. M.L.

A77-34933 # **The competitive market for commercial VSTOL.** R. K. Ransone (Vought Corp., Dallas, Tex.). In: V/STOL Conference, Palo Alto, Calif., June 6-8, 1977, Technical Papers. New York, American Institute of Aeronautics and Astronautics, Inc., 1977, p. 40-46. 7 refs. (AIAA 77-573)

Cost-productivity, proposed as a valid measure of aircraft usefulness, is defined for civil passenger aircraft as the number of passengers times the cruise speed divided by aircraft unit cost. This concept is used to identify potential markets for commercial V/STOL aircraft, indicating poor market penetration by jet V/STOL of the jet transport market. B.J.

A77-34972 **Features of systems for transmission of concentrated solar radiation.** V. K. Baranov (Gosudarstvennyi Opticheskii Institut, Leningrad, USSR). *(Geliotekhnika, no. 5, 1976, p. 15-25.) Applied Solar Energy*, vol. 12, no. 5, 1976, p. 12-19. 5 refs. Translation.

The paper examines a system for transmitting concentrated solar energy over various distances, which uses hollow optical waveguides to gather rays in the output pupil after reflection from the waveguide walls. The relations between transmission capacity and the ratios of concentrator to waveguide diameter and waveguide length to concentrator geometry are investigated. The reflection coefficient of several waveguide materials (Cu, Al, and Ag) is studied. B.J.

A77-34973 **Energy computation of concentrating capability of paraboloidal facets.** R. A. Zakhidov and A. Sh. Khodzhaev (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *(Geliotekhnika,* no. 5, 1976, p. 26-30.) *Applied Solar Energy*, vol. 12, no. 5, 1976, p. 20-23. Translation.

The distribution of radiant vectors in the concentration field of long-focal paraboloidal mirrors (facets) of solar concentrators at different angles of incidence is studied. Formulas are obtained for the distribution of radiant flux density on planes perpendicular to the incident rays. B.J.

A77-34974 **Thermodynamic analysis and choice of optimal parameters of dynamic converter for solar energy plant.** G. Ia. Umarov, B. B. Orunov, Iu. E. Kliuchevskii, I. A. Tursunbaev, and V. S. Trukhov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *(Geliotekhnika,* no. 5, 1976, p. 31-34.) *Applied Solar Energy,* vol. 12, no. 5, 1976, p. 24-26. Translation.

A77-34975 **Calculation of radiation entering 'hot box' solar unit.** O. L. Shvaleva and R. R. Avezov (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *(Geliotekhnika,* no. 5, 1976, p. 35-39.) *Applied Solar Energy,* vol. 12, no. 5, 1976, p. 27-30. Translation.

The paper calculates a number of parameters of a solar heating set-up with southern orientation including: the total solar radiation input, the useful heat obtained, and the energy conversion efficiency. The analysis of these data indicates that vertical solar set-ups are more advantageous than oblique set-ups for heating, a conclusion confirmed by an increase of the total solar radiation input from autumn to winter. B.J.

A77-35015 **Statistical utility theory for comparison of nuclear versus fossil power plant alternatives.** S. Garribba and A. Ovi (Milano, Politecnico, Milan, Italy). *Nuclear Technology,* vol. 34, June 1977, p. 18-37. 32 refs. Consiglio Nazionale delle Ricerche Contract No. 75,01172,11,115,4858.

A statistical formulation of utility theory is developed for decision problems concerned with the choice among alternative strategies in electric energy production. Four alternatives are considered: nuclear power, fossil power, solar energy, and conservation policy. Attention is focused on a public electric utility thought of as a rational decision-maker. A framework for decisions is then suggested where the admissible strategies and their possible consequences represent the information available to the decision-maker. Once the objectives of the decision process are assessed, consequences can be quantified in terms of measures of effectiveness. (Author)

A77-35016 * **Institutional and environmental aspects of geothermal energy development.** O. R. Citron (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Nuclear Technology,* vol. 34, June 1977, p. 38-42.

Until recently, the majority of work in geothermal energy development has been devoted to technical considerations of resource identification and extraction technologies. The increasing interest in exploiting the variety of geothermal resources has prompted an examination of the institutional barriers to their introduction for commercial use. A significant effort was undertaken by the Jet Propulsion Laboratory as a part of a national study to identify existing constraints to geothermal development and possible remedial actions. These aspects included legislative and legal parameters plus environmental, social, and economic considerations. (Author)

A77-35030 * # **The sun-tracking control of solar collectors using high-performance step motors.** R. O. Hughes (California Institute of Technology, Jet Propulsion Laboratory, Control and Energy Conversion Div., Pasadena, Calif.). *University of Illinois, Annual Symposium on Incremental Motion Control Systems and Devices, 6th, Urbana, Ill., May 24-27, 1977, Paper.* 8 p. 8 refs. Contract No. NAS7-100.

Sun-tracking solar energy-focusing devices involving a central receiver, thermionic conversion, or a distributed solar thermal collector system are described. The Perkins solar collector uses a fixed focal point about which an 18 m-diameter parabolic dish moves on tracks. The elevation axis also moves on a circular track. A microprocessor manipulates sun sensor information and sun ephemeris data to ensure correct placement. Stepper motors are digital devices which provide direct interface with digital electronics and a wide dynamic range, and could easily be associated with the microprocessors. Design philosophy, performance criteria, wind load analysis, and control system requirements are also discussed. M.L.

A77-35146 **Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975.** Conference sponsored by the American Institute of Chemical Engineers. Edited by E. J. Rolinski (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio), A. J. Buonicore (Entoleter, Inc., New Haven, Conn.), D. E. Earley (Monsanto Research Corp., Dayton, Ohio), L. Theodore (Manhattan College, Bronx, N.Y.), R. F. Rolsten, and R. A. Servais (Dayton, University, Dayton, Ohio). Dayton, Ohio, American Institute of Chemical Engineers, 1975. 415 p. $22.50.

Attention is given to energy policy and utilization, energy requirements and performance, and alternate energy sources. Also considered are solid waste disposal and resource recovery, waste heat management, air quality sampling and monitoring techniques, the control of gases and particulates, and fugitive dust and emissions. B.J.

A77-35147 **The development of net energy estimates for extraction, handling, and processing of selected fuels.** A. J. Frabetti, Jr., R. A. Lovell, Jr., C. Sheldon, II (Development Sciences, Inc., East Sandwich, Mass.), and A. W. Decora (ERDA, Laramie Energy Research Center, Laramie, Wyo.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 3-8. U.S. Department of the Interior Contract No. 14-01-0001-2141.

A combination of process analysis and input/output theory was used to calculate the true energy costs to society associated with the delivery of a given amount of usable energy (1000 Btu) by various energy systems. The various steps associated with each energy delivery pathway were analyzed in a modular fashion, with conversion of the external direct and indirect energy inputs. Attention was given to fossil fuel and electricity pathways. B.J.

A77-35148 **The EPA role in energy research and development.** G. J. Foley (U.S. Environmental Protection Agency, Washington, D.C.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 9-24. 6 refs.

Attention is given to the EPA energy program planning structure and to the following components of the planning matrix: energy sources, energy cycle components, and areas of functional concern. Also considered are the environmental control technology program (research extraction, physical/chemical coal cleaning, etc.), the environmental effects of energy use, program organization, and interagency coordination. B.J.

A77-35149 **Use of municipal waste for fuel.** M. Golar (Commission on Critical Choices for Americans, Washington, D.C.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 34-39. 24 refs.

The recovery or generation of steam, solid fuel, liquid fuel, gaseous fuel, and electricity from municipal waste is considered. Attention is also given to the markets for waste recovery systems, the obstacles involved and the demand for recycled materials. B.J.

A77-35150 **Aviation turbine fuels from shale and coal oils.** H. Shaw, C. D. Kalfadelis, and C. E. Jahnig (Exxon Research and Engineering Co., Government Research Laboratories, Linden, N.J.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 40-48. 11 refs. Contract No. F33615-74-C-2036.

A three phase program is described. The first recently completed initial phase determined which domestic sources of synthetic crudes (shale, coal, etc.) can be used as refinery feedstocks to produce aviation turbine fuels. The second phase is intended to experimentally confirm the suitability of synthetic crudes produced from oil shale and coal as sources for a wide-cut and narrow-cut jet fuel. The final phase will assess the engineering and economic factors for producing aviation turbine fuels from synthetic sources. B.J.

A77-35151 Materials utilization in a direct coal-fired MHD generator system. N. L. Loeffler and L. W. Crawford (Tennessee, University, Tullahoma, Tenn.). In: *Energy and the environment;* Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 49-56. 20 refs. Contract No. E(49-18)-1760.

The paper discusses means for controlling the viscosity of a slag deposit and the chemical reactions between a slag deposit and the internal walls of a coal-fired MHD plant. The degree of variability of such parameters as oxygen and water partial pressures and temperatures is considered on a theoretical basis. Recent results concerning slag deposits formed in the MHD test device of the University of Tennessee Space Institute are also considered. B.J.

A77-35153 Simple thermal decomposition reactions for storage of solar thermal energy. W. E. Wentworth and E. Chen (Houston, University, Houston, Tex.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 64-69. 6 refs. Research supported by the University of Houston.

The paper considers the uncatalyzed decomposition of such classes of salts as ammonium salts and Group IA and IIA hydroxides, carbonates, sulfates, and oxides, for the storage of solar energy. Ten specific criteria are given which can be used to select the most appropriate chemical reaction for storing solar energy, capable of producing high temperature heat sufficient to generate electrical power. B.J.

A77-35154 Solar heating and cooling systems - A reality today. J. Schultz (Solar Utilities Co., San Diego, Calif.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 80-92.

Solar heating and cooling are discussed with regard to solar energy collection efficiency, and economic availability. Detailed attention is given to energy conservation priorities including space or comfort heating, passive solar cooling/heating systems, and the Skytherm principle. Also considered are capital investment/equipment costs, cost effectiveness, and financing. B.J.

A77-35155 The production of shale oil crude and its refining into military operational fuels. H. Bartick (Applied Systems Corp., Arlington, Va.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 93-99. Contract No. N00014-75-C-0055.

The production of 5,765 bbl of various military fuels (JP-4, JP-5/Jet-A, DFM/DF-2, gasoline, Heavy Fuel Oil) from 10,000 bbl of crude shale oil was accomplished in a commercial small-scale refinery having a capacity of about 9,000 BPSD. The 10,000 bbl of crude shale oil was produced by the Paraho process using the shale mined from the Naval Oil Shale Reserve located at Anvil Points, Colorado. The various fuels produced met a majority of the military, federal, and commercial specifications' requirements. However, these fuels tended to exhibit storage and thermal instabilities. In addition, the fuels contained a high wax content, high particulate matter, and high gum content. It is believed that a higher pressure in the hydrogenation stage (about 1500-3,000 psi), along with clay treatment of the final products, would reduce or eliminate some or most of these problem areas. (Author)

A77-35156 Refuse to energy Memphis style. J. W. Smith (*Memphis State University, Memphis, Tenn.*). In: *Energy and the environment;* Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 100-105.

A summary is presented of the efforts of the City of Memphis to implement a solid waste recovery system. Attention is given to markets, separation systems, costs, acceptability, and regional considerations. B.J.

A77-35157 Environmental and technical considerations concerning energy recovery from refuse combustion. J. C. Reed, F. W. Sherman, L. Weitzman, and C. N. Click (Illinois Environmental Protection Agency, Springfield, Ill.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 106-111. 19 refs.

A number of environmental factors to be considered in using refuse as fuel are considered. They are: (1) the use of a consistent set of definitions to determine if a device is a fuel combustion device or an incinerator with heat recovery, (2) use of programmed combustion calculations to predict flow rates, compositions, and temperatures for a wide variety of possible combinations of refuse and conventional fuel, (3) prediction of particulate emissions from refuse fuel combustion devices, and (4) application of the F-Factor method to stack tests of refuse-fuel combustion devices. B.J.

A77-35158 Recovering resources from urban refuse by the Bureau of Mines processes. R. S. DeCesare (U.S. Bureau of Mines, College Park, Md.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 112-117. 7 refs.

The paper presents a review of the operation of the continuous pilot plant of the Bureau of Mines for reclaiming the metals and minerals contained in the residues of incinerated municipal waste. Performance evaluations and economic analyses are presented of the incinerator residue process and the raw refuse process. B.J.

A77-35159 Energy recovery from solid waste using the Union Carbide Purox system. T. A. Donegan (Union Carbide Corp., Tarrytown, N.Y.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 118-123.

The Purox system uses oxygen instead of air to produce high-temperature incineration and pyrolysis of all types of refuse, with the only products being a compact sterile residue and a fuel gas valuable as a clean-burning source of energy. A description is given of the system and attention is paid to resource recovery, pilot operation, economics, and oxygen supply. B.J.

A77-35160 Energy recovery from low heating value industrial waste. J. J. Santoleri (Trane Thermal Co., Conshohocken, Pa.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 124-132. 6 refs.

The paper discusses liquid and gaseous wastes as a heat source and presents case histories of systems applied in industry. Particular attention is given to the use of a highly efficient vortex combustor which completely burns gaseous wastes with heating values as low as 90 Btu/cu ft, and liquid wastes with heating values up to 4500 Btu/lb. B.J.

A77-35162 **The Garrett oil-from-waste process and resource recovery system.** E. T. Titlow and J. K. McCartney (Garrett Research and Development Co., LaVerne, Calif.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 192-198.

A system and flowsheet for recovery of secondary resources (including petroleum) from municipal wastes is described; the system is optimized for recovery of high-grade readily marketable material, rather than for low cost. Two distinct subsystems are studied: (1) feedstock preparation (recovery of metals and glass), and (2) pyrolysis (recovery of saleable fuels). Economic recovery of magnetic metals, aluminum, and clean glass is viewed as a secondary goal. The principal products recovered (glass, Al, pyrolytic oil, solid fuels), process economics, and the unit operations (primary shredding, magnetic separation, classification, drying, screening, secondary shredding, flash pyrolysis) are described. R.D.V.

A77-35163 **Torrax - A system for recovery of energy from solid waste.** F. J. Page (Carborundum Environmental Systems, Inc., Niagara Falls, N.Y.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 199-204.

A system designed to convert energy carriers in solid wastes to transportable fuel is described. The Torrax system described comprises a slagging pyrolysis process for recovery of energy in solid wastes. Process equipment, combustion characteristics of the product fuel, and some applications are discussed. The Torrax fuel is recommended as a base load fuel for steam generation, or as a supplementary fuel for large boiler systems. The hydrogen content of the fuel ensures adequate flame stability and adequate combustion temperature. R.D.V.

A77-35164 **District heating with refuse derived fuel at Wright-Patterson Air Force Base.** A. J. Buonicore (Entoleter, Inc., New Haven, Conn.) and J. P. Waltz (USAF, Wright-Patterson AFB, Ohio). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 205-214. 6 refs.

A heating system which used a 1:1 by volume mixture of coal and refuse-derived fuel pellets is described and evaluated. The fuel mixture was found to be suitable for the system, although problems involving odor control and potential scaling or corrosion were noted. The amounts of hydrocarbons in the stack emissions were reduced. It is suggested that larger and more dense pellets might permit higher pellet/coal ratios to be used in stoker-fired boilers. M.L.

A77-35167 **State of the art of particulate and SO2 removal on coal fired boilers.** R. W. McIlvaine (McIlvaine Co., Northbrook, Ill.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 257-261.

Pollution control procedures for removing particulates and SO2 from coal-fired boiler stack gases are reviewed. The capabilities of precipitators and scrubbers for removing particulates are compared, as are the traditional SO2 removal techniques, the lime and limestone system and the double alkali system. New recovery processes for SO2 removal are described, and a cost analysis of both traditional and new removal processes is provided. It is suggested that reliability of magnesium oxide scrubbing systems will soon be obtained. M.L.

A77-35168 **Synthetic additives for SO2 removal from combustion gas in a fluidized-bed coal combustor.** R. B. Snyder, W. I. Wilson, G. J. Vogel, and A. A. Jonke (Argonne National Laboratory, Argonne, Ill.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 262-266. 12 refs. ERDA-supported research.

The reactivity of CaO supported on alpha-alumina with sulfur dioxide and oxygen, and the regenerability of this sorbent after sulfation, are discussed. The alumina support was chosen for its strength, its ability to withstand fluidization and stresses induced by the chemical conversions. The support is stable at high temperatures (upwards of 1050 C) needed for regeneration. The regeneration method involves contacting the sulfated sorbent at 1100 C with a reducing gas (methane, hydrogen, carbon monoxide) to convert the calcium sulfate to calcium aluminates. R.D.V.

A77-35169 **A method for evaluating SO2 abatement strategies.** C.-T. Chi, E. D. Eimutis, W. H. Hedley, and L. B. Mote (Monsanto Research Corp., Dayton, Ohio). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 267-275. 6 refs.

An economic evaluation of SO2 abatement methods of different generic types has been obtained by a probabilistic approach. This method can be applied to a group of sources which have a wide range of capacities and locations. Uncertainties in input variables are treated by using probability distribution functions. A common cost factor for comparing SO2 abatement methods has been defined as airport area noise loadings. Noise nuisance criteria are compared. Economic disadvantages of nighttime airport curfews are examined. Data on air pollution by airport operations are deemed inadequate. Noise associated with general aviation and training flights at smaller airports is also considered. R.D.V.

A77-35172 **Particulate sampling at high temperature and high pressure.** D. R. Blann (Acurex Corp., Aerotherm Div., Mountain View, Calif.). In: Energy and the environment; Proceedings of the Third National Conference, Oxford, Ohio, September 29-October 1, 1975. (A77-35146 15-42) Dayton, Ohio, American Institute of Chemical Engineers, 1975, p. 351-356. Research supported by the U.S. Environmental Protection Agency.

Design requirements for particulate- and gas-sampling devices suitable for studying new coal conversion processes are discussed. Coal conversion processes such as fluidized bed combustion, coal gasification, combined-cycle power plants, and hot-gas cleanup techniques operate at high pressure (as high as 100 atmospheres) and high temperatures (to 2000 F). Although traditional sampling techniques are used, the high temperatures and pressures, along with corrosion and erosion, necessitate design innovations and the use of exotic materials. Special procedures must be devised for process constituents with high condensation temperatures. Difficulties associated with different sampling steps are analyzed, and design features of a recently developed sampler are presented. M.L.

A77-35186 **Soot and gaseous pollutant formation in a burning fuel spray in relation to pressure and air/fuel ratio.** M. S. Janota, R. J. Crookes, S. J. Daie, M. A. A. Nazha, and M. Sodha (Queen Mary College, London, England). *Institute of Fuel, Journal*, vol. 50, Mar. 1977, p. 10-13. Research supported by CAV, Ltd., Rolls-Royce (1971) Ltd., English Electric Diesels, Ford of Britain Trust, and Science Research Council.

The authors describe a combustion chamber capable of maintaining the steady state combustion of a diesel-type fuel spray *without swirl, premixing or recirculation mechanically introduced* near to the injector. Measurements of pollutants were made in the flame zone of the combustion chamber and near to the exhaust orifice. Experimental results are presented as contours of constant concentrations of soot and gaseous species within the combustion chamber. Graphs are also presented showing the effects of equivalence ratio and combustion chamber pressure on the pollutant emissions from the chamber. There is a central zone of high soot concentration within the chamber followed by a peak in the carbon

monoxide concentration. The carbon monoxide levels at the exit are lower at the higher pressures but the soot content is higher. (Author)

A77-35188 **Chemical reduction of SO3, particulates and NOx emissions.** I. Kukin and R. P. Bennett (Apollo Chemical Corp., Whippany, N.J.). *Institute of Fuel, Journal,* vol. 50, Mar. 1977, p. 41-46. 17 refs.

The chemical treatment of fuels and flue gas to reduce polluting emissions was subjected to quantitative field tests to verify its practicality as a possible economic solution to current energy and pollution problems for electric utilities. Manganese added to a residual fuel oil at 50 ppm reduced sulphur trioxide emissions by up to 55%. Manganese has also been effective in reducing nitrogen oxide emissions by as much as 31%. Chemical conditioning agents for the ash in the flue gas of coal-fired units have been used to improve electrostatic precipitator collection efficiency by 50-90%, so that the

A77-35301 **Space Congress, 14th, Cocoa Beach, Fla., April 27-29, 1977, Proceedings.** Congress sponsored by the Canaveral Council of Technical Societies. Cocoa Beach, Fla., Canaveral Council of Technical Societies, 1977. 283 p. $21.25. (For individual items see A77-35302 to A77-35329)

Attention is given to the shuttle program, shuttle payloads, and shuttle launch site operations. Also considered are solar applications of space technology, international aerospace programs, and unmanned space programs such as Navstar/GPS. B.J.

A77-35316 **Solar energy, its conversion and utilization.** E. A. Farber (Florida, University, Gainesville, Fla.). In: Space Congress, 14th, Cocoa Beach, Fla., April 27-29, 1977, Proceedings. (A77-35301 15-12) Cocoa Beach, Fla., Canaveral Council of Technical Societies, 1977, p. 4-1 to 4-4.

The availability and characteristics of solar energy are considered. Attention is given to the determination of the solar properties of material with the aid of a solar calorimeter, aspects of solar water heating, solar house heating, solar air conditioning systems, solar distillation and fresh water production, cooking and baking by means of solar furnaces, solar engines, questions of solar to electric conversion, and electric vehicles whose batteries can be charged with solar energy. G.R.

A77-35317 **The University of Florida solar house.** H. A. Ingley (Florida, University, Gainesville, Fla.). In: Space Congress, 14th, Cocoa Beach, Fla., April 27-29, 1977, Proceedings. (A77-35301 15-12) Cocoa Beach, Fla., Canaveral Council of Technical Societies, 1977, p. 4-5 to 4-11. 8 refs.

Over the past 20 years, the University of Florida Solar Laboratory has contributed substantially to the knowledge now used in solar energy applications. One of the primary research objectives in recent years has been the utilization of solar energy at the residential level. Research in the areas of solar space heating and cooling, solar heated domestic water, solar cooking, and solar distillation of waste water are examples of the effort being made to meet this objective. This paper presents information on each of these efforts. Details on system component design and evaluation are also included in this discussion. (Author)

A77-35318 **Solar properties of materials and testing of solar systems.** C. A. Morrison (Florida, University, Gainesville, Fla.). In: Space Congress, 14th, Cocoa Beach, Fla., April 27-29, 1977, Proceedings. (A77-35301 15-12) Cocoa Beach, Fla., Canaveral Council of Technical Societies, 1977, p. 4-12 to 4-17.

The performance of solar energy equipment depends on the characteristics of its components. The manner in which these characteristics is established is considered. Aspects of instrumentation and data retrieval are examined. It is recommended to use mercury thermometers whenever possible. For an evaluation of the amount of heat which is dissipated through the sides and the back of solar collectors or storage vessels, it is necessary to determine the overall heat transfer characteristics of the barrier that separates the heat interior of the device from ambient conditions. The determination of the system operational conditions is also discussed. G.R.

A77-35319 **Solar cooling of a Florida welcome station - A demonstration.** G. W. Lowery (Florida Solar Energy Center, Cape Canaveral, Fla.). In: Space Congress, 14th, Cocoa Beach, Fla., April 27-29, 1977, Proceedings. (A77-35301 15-12) Cocoa Beach, Fla., Canaveral Council of Technical Societies, 1977, p. 4-18 to 4-22. ERDA-supported research.

A77-35349 # **Comparative discussion on measurements of atmospheric natural radioactivity and pollution by coal smoke particles (Discutia comparativa a unor masuratori de radioactivitate naturala si poluare cu fum de carbune a aerului).** M. Zoran (Institutul de Fizica Pamintului si Seismologie, Rumania). *Studii si Cercetari de Fizica,* vol. 29, no. 5, 1977, p. 433-442. In Rumanian.

The results of measuring natural radioactivity and coal smoke pollution are discussed for two sites in an industrial town, and for two heights at the same site, in connection with large-scale and local atmospheric stability. The effects of the radiation fog upon the radon daughter buildup near the ground are examined in some detail. By comparing the pollutant diurnal variations during two periods of similar atmospheric stability in autumn and in winter, the contribution by local coal heating is estimated at about half of the total pollution in the town. (Author)

A77-35399 # **Contribution to the solution of planning problems in electric power generation /effects of random disturbances/ (Prispevek k reseni problematiky planovani vyroby elektricke energie /respektovani vlivu nahodnych poruchovych vypadku/).** M. Vlcek (Ceske Energeticke Zavody, Czechoslovakia). *Energetika* (Prague), Apr. 1977, p. 145-150. In Czech.

Construction of a quantitative model for a power generation system, fuel costs, and random disturbances to the system is discussed. A statistical method aiding planning of electric power generation while dealing with random outages and failures is outlined. Numerical examples are worked out. Quantification of expected increases in power generation (with rising fuel costs), and of the effect of changes in the probability of the state of operational readiness of specific units of the power plant on the output level of those units, of the remaining units in the system, of auxiliary units, and effects of reliability, are treated by the model. R.D.V.

A77-35400 # **The outlook for more efficient fuel utilization in generation of process heat (Moznosti racionalizace spotreby paliv pri vyrobe tepla k vytapeni).** M. Rybin (Ustav pro Vyzkum a Vyuziti Paliv, Prague, Czechoslovakia). *Energetika* (Prague), Apr. 1977, p. 180-183. In Czech.

Major goals of the state-promoted fuel efficiency program are outlined, and opportunities for fuel savings and improving efficiency in fuel and energy utilization are examined. The limited quantity and declining grade of Czechoslovak coal reserves are noted. The development of fuel and energy guidelines for energy-consuming industries, factors responsible for uneconomic use of heat by fuel consumers, and the design of multifuel systems and combustion of burnable wastes are discussed. Heightened mechanization and process automatization are recommended for increased fuel utilization efficiency combined with a cleaner work environment. R.D.V.

A77-35415 # **Tests of a combined wind and solar power plant under natural conditions (Ispytaniia geliovetroenergeticheskikh ustanovok v naturnykh usloviiakh).** Kh. Khallyev, S. Seiitkurbanov, and R. Bairamov (Akademiia Nauk Turkmenskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). *Akademiia Nauk Turkmenskoi SSR Izvestiia, Seriia Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk,* no. 1, 1977, p. 110-114. In Russian.

A combined wind and solar energy system based on principles outlined by Bajronov et al., (1976) was tested at a watering station in the Bakhardenskyi region over a six-month period. Results are compared with calculations based on the mean amounts of solar and wind energy available in that area. The mean output of the wind-driven generator was 418.5 kW/hr, compared with a theoretical value of 720.0 kW/hr; corresponding figures for the solar-driven generator were 526.1 kW/hr and 794.2 kW/hr. Poor weather conditions during two months adversely affected the performance of the system. However, results are sufficiently encouraging to indicate a promising role for such systems in power production for rural and isolated areas. C.K.D.

A77-35607 # **Structure of the electric field in the near-end space of a cylindrical electrode (Struktura elektricheskogo polia v pritortsevom prostranstve tsilindricheskogo elektroda).** I. G. Panevin and V. N. Khazov (Moskovskii Aviatsionnyi Institut, Moscow, USSR). *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriia Tekhnicheskikh Nauk,* Feb. 1977, p. 75-81. 18 refs. In Russian.

Under the assumption of the uniform distribution of charges in the electrodes, the integral method is used to derive an approximate analytical expression for calculating the variations of the axial component of the electric field strength vector for the three-dimensional near-end space (vacuum) of a cylindrical electrode. It is shown that the solution obtained satisfies the Laplace equation. The discussion is applicable to electrodes used in MHD generators and other plasma devices. B.J.

A77-35675 **The uses of air photography /2nd edition/.** Edited by J. K. S. Saint Joseph (Cambridge University, Cambridge, England). London, John Baker (Publishers), Ltd., 1977. 194 p. $16.35.

The scope of air photography is examined and aspects of air photography and cartography are investigated, taking into account the effect of height distortion, the parallax bar, the assembling of slotted templates, a modern analog-type plotting machine, single image photogrammetry, flight lines of an aircraft on survey, the schematic diagram of a stereoscope, the measurement of parallax, and the working principles of the multiplex plotter. Attention is also given to air photography and geology, air photography and geography, air photography and soil science, air photography and plant ecology, air photography and plant disease, air photography and zoology, air photography in East African game management, air photography and archaeology, air photography and history, towns and monumental buildings, and contemporary planning. G.R.

A77-35798 # **Calculation of the electric fields and currents in a plasma flowing in a spatially periodic magnetic field (K raschetu elektricheskikh polei i tokov v plazme, tekushchei v prostranstvenno-periodicheskom magnitnom pole).** L. V. Gorodzha, V. A. Krutilin, and A. P. Rashchepkin. *Magnitnaia Gidrodinamika,* Jan.-Mar. 1977, p. 56-62. 5 refs. In Russian.

In the present paper, analytical methods are applied to the analysis of electric processes occurring in a plasma that flows in an external periodically varying magnetic field. This situation is characteristic of Hall generators employing one electrode at either channel end. The analysis, carried out by the method of Riemann's boundary value problem for automorphic functions, leads to estimates of the energetic characteristics of a Hall-type MHD generator with an alternating magnetic field and to an expression relating the energetic characteristics to the channel geometry. V.P.

A77-35799 # **Internal problem for the end effect in a linear asynchronous MHD-machine operating at an arbitrary current load (Vnutrenniaia zadacha kontsevogo effekta v lineinoi asinkhronnoi MGD-mashine pri proizvol'noi tokovoi nagruzke).** A. Ia. Vilnitis. *Magnitnaia Gidrodinamika,* Jan.-Mar. 1977, p. 63-72. 12 refs. In Russian.

The internal end-effect problem under consideration is solved by the method of varying the constants for an arbitrary surface current load, including the case of discrete windings. For the latter case, mathematically correct formulas are derived for calculating the mechanical coil forces and useful power. Some means of end-loss compensation are examined. V.P.

A77-35801 * **Space manufacturing facilities: Space colonies; Proceedings of the Princeton Conference, Princeton University, Princeton, N.J., May 7-9, 1975.** Conference sponsored by the American Institute of Aeronautics and Astronautics, and NASA. Edited by J. Grey (American Institute of Aeronautics and Astronautics, New York, N.Y.). New York, American Institute of Aeronautics and Astronautics, Inc., 1977. 324 p. $19.50. (For individual items see A77-35802 to A77-35838)

Reports submitted to the conference encompass: administration and law relating to inhabited space facilities and colonies; space manufacturing and processing; organization and construction of space habitats and management of space colony farms; winning and acquisition of lunar and asteroidal materials for sustaining autonomous space colonies. Attention is given to trajectories between earth, low earth orbit, earth-moon libration points (specifically L5), circumlunar parking orbits, and trajectories in translunar space; effects of low gravity and zero gravity on human physiology and on materials processing; architecture and landscaping for space colonies; closed ecosystems of space colonies. Varieties of human cultures and value hierarchies around the earth are examined for broader perspectives on the social organization of space colonies. R.D.V.

A77-35805 # **Deep space material sources.** K. E. Drexler (MIT, Cambridge, Mass.). In: Space manufacturing facilities: Space colonies; Proceedings of the Princeton Conference, Princeton, N.J., May 7-9, 1975. (A77-35801 16-12) New York, American Institute of Aeronautics and Astronautics, Inc., 1977, p. 29, 30; Discussion, p. 30, 31.

Three ways of using materials present in the asteroid belt to advantage for the local support of deep-space colonies are discussed. Asteroids are judged equivalent 'in virtually all respects' as a resource base to the earth. Energy, metals, and organic materials necessary to support and develop colonies are available; hydrogen and water resources, about one-half the organic materials content of terrestrial oil shale, and iron can be acquired. Iron is judged present in large chunks (many km in diameter) down to fine dust; it is viewed as strong, tough, ductile, corrosion-resistant, containing approximately 5% nickel and 'for engineering purposes . . . superior to most of the steel produced on . . . earth.' Estimates are offered for capital costs, materials transportation costs, processing costs, and a thousand 100 megaton H-bombs for processing. R.D.V.

A77-35810 # **Near-term chemically-propelled space transport systems.** A. O. Tischler. In: Space manufacturing facilities: Space colonies; Proceedings of the Princeton Conference, Princeton, N.J., May 7-9, 1975. (A77-35801 16-12) New York, American Institute of Aeronautics and Astronautics, Inc., 1977, p. 71-75; Discussion, p. 75, 76.

Energy requirements and maneuver calculations for launching and conveying required loads from earth to L5 libration point, and from low earth orbit (LOE) to a lunar parking orbit (LPO) or to the lunar surface, are discussed. Data referable to placing 50,000 tons and 10,000 persons at L5 or in LOE, and to delivery of 200 persons and 3000 tons to the lunar surface, are presented and tabulated. Deployable-retrievable hydrogen-oxygen chemical propulsion systems (single-stage or two-stage) and a schedule for modular delivery of Shuttle loads to LOE are discussed. R.D.V.

A77-35812 # **Industrial development in zero-G.** L. R. McCreight (GE Space Sciences Laboratory, Valley Forge, Pa.). In: Space manufacturing facilities: Space colonies; Proceedings of the Princeton Conference, Princeton, N.J., May 7-9, 1975. (A77-35801 16-12) New York, American Institute of Aeronautics and Astronautics, Inc., 1977, p. 87-97; Discussion, p. 97.

The feasibility of gravity-free processing of materials (derived from earth or elsewhere) in space stations at libration points L4 or L5 is assessed for a variety of materials, with emphasis on biologicals, and also electronics and electro-optics materials. Exploration for lunar minerals is also discussed. Attention is drawn to phenomena not driven by gravity, and hence likely to influence deep-space processing (advantageously or not): surface tension, diffusion, heat transfer by conduction and radiation. Electrophoretic separation, freeze-drying, preparation of vaccines/lipoproteins/erythropoietin, immunoproteins, and isolation of normal and cancerous cells are discussed, along with crystal growing, convectionless unidirectional solidification, eutectic solidification, and containerless processing.
R.D.V.

A77-35815 # **Development of the satellite solar power station.** P. E. Glaser (Arthur D. Little, Inc., Cambridge, Mass.). In: Space manufacturing facilities: Space colonies; Proceedings of the Princeton Conference, Princeton, N.J., May 7-9, 1975. (A77-35801 16-12) New York, American Institute of Aeronautics and Astronautics, Inc., 1977, p. 115-127; Discussion, p. 127, 128.

The economic and social acceptability and feasibility of a satellite solar power station (SSPS) beaming intercepted solar energy at microwave frequencies to receiving stations on the earth (ERS) are evaluated. With 24-hr constant energy input, there are no energy storage problems in space; solar energy available in synchronous orbit is 6-15 times that available optimally at the earth's surface; technological problems appear readily surmountable. Microwave-transparent mechanical structures, interference with frequency ranges already in use, social costs of the ERS, ERS land use, ERS thermal pollution, ERS and SSPS materials requirements, and exposure to high-power microwave beams (affecting birds, aircraft) are considered. A 30-yr lifetime for solar photovoltaic cells fabricated in space is predicted. Advantages of beaming the energy down to offshore ERS or ERS occupying low-value land are discussed.
R.D.V.

A77-35816 # **Closed Brayton cycle turbines for satellite solar power stations.** G. Woodcock (Boeing Co., Seattle, Wash.). In: Space manufacturing facilities: Space colonies; Proceedings of the Princeton Conference, Princeton, N.J., May 7-9, 1975. (A77-35801 16-12) New York, American Institute of Aeronautics and Astronautics, Inc., 1977, p. 129-133.

The paper discusses the design and construction of a proposed 11-km-long satellite that would concentrate solar energy into a thermal cavity for use in turbine power generation. The satellite is intended to provide 10,000 megawatts and would use heat engines for converting sunlight to electricity. It is suggested that near-term technology systems are adequate for assembling the satellite in low-earth orbit. Assembly of the 60,000-metric-ton satellite might involve a continuous 'gutter' machine which, starting with a flat roll of aluminum, can produce square beams of whatever length is desired. An economic analysis of several aspects of the project is offered.
M.L.

A77-35920 **Thermonuclear fusion power.** B. Lehnert (Kungl. Tekniska Hogskolan, Stockholm, Sweden). *International Journal of Energy Research*, vol. 1, Jan.-Mar. 1977, p. 5-23. 110 refs.

The present state and future possibilities of controlled-nuclear-fusion research are reviewed, including basic concepts and problems, as well as various approaches based on magnetic- and nonmagnetic-confinement schemes. Considerable progress has so far been made in both plasma physics and fusion-reactor technology, and a closer relationship has been established between theory and experiments. Still, none of the present approaches will, for certain, lead to the final solution of a full-scale reactor. Intensified work along broad lines, with emphasis also on basic research and new ideas, is necessary for future success.
(Author)

A77-35921 **Cathodes for photodriven hydrogen generators - ZnTe and CdTe.** K. Ohashi, K. Uosaki, and J. O. Bockris (South Australia, Flinders University, Adelaide, Australia). *International Journal of Energy Research*, vol. 1, Jan.-Mar. 1977, p. 25-30. 6 refs.

ZnTe and CdTe were studied as possible candidates for a photocathode in the photoelectrochemical production of hydrogen. Current-potential relationships with and without light, photocurrent-wavelength relationships at various potentials, and the flatband potential, were measured for both electrodes in 1 N NaOH solution. The stabilities of both electrodes in NaOH solution were also examined. CdTe is a possible photocathode, but ZnTe is unacceptable, because the photocurrent appears at a too-negative potential in relation to its negative flatband potential, and because of its low stability.
(Author)

A77-35922 **The interaction of automotive-engine efficiency and exhaust pollution.** J. R. Goulburn (Belfast, Queen's University, Belfast, Northern Ireland) and D. W. Hughes (Babcock and Wilcox, Ltd., Renfrew, Scotland). *International Journal of Energy Research*, vol. 1, Jan.-Mar. 1977, p. 31-46. 25 refs.

Recent design trends of automotive petrol engines, brought about by the need to meet exhaust-emissions legislation, are discussed. It is explained why many of the consequent changes have the side effect of seriously increasing fuel consumption. The conventional inlet system is isolated as a major cause of poor combustion, which leads to the presence of much of the pollutants, and to low engine efficiency. A historical survey is included on the events leading to the present-day exhaust-emission legislation, and the sources of effects of and conventional methods of control of the major pollutants are discussed. An alternative approach to the reduction of exhaust emissions has recently attracted interest. Mixture preparation as a means of delivering a near-homogeneous mixture to the engine cylinders has the combined effect of reducing exhaust emissions and fuel consumption. A survey of research and recent applications of this method is included. A method of achieving a near-homogeneous mixture which is simple and effective, and which has been developed by the authors, is described. The results of a lengthy programme of tests in both a laboratory situation and in a car 'on the road' are presented and discussed. The encouraging conclusion is drawn that this approach (mixture pretreatment and lean mixture) does indeed result in cleaner exhaust gases and reduced petrol consumption.
(Author)

A77-35923 **Utilizing alternative energy sources in France.** M. Magnien (Electricité de France, Paris, France). *International Journal of Energy Research*, vol. 1, Jan.-Mar. 1977, p. 55-67. 7 refs.

The relative merits of various alternative-energy sources are discussed with particular reference to their suitability in the French context. The case is presented for decentralized solar power as against centralized solar-power production, and some test installations in France are described. The potential for geothermal power is examined, and it is shown that the resource is essentially non-renewable. A history of wind generation in France is presented, and power extraction from the seas is discussed, with particular reference to the Rance tidal-power scheme. While the public romance with alternative-energy schemes is accepted, it is pointed out that this may only last for as long as their implementation is on a small scale.
(Author)

A77-35956 **Investigation of the causes of stuck servovalves in U.S. Army hydraulic systems using MIL-H-46170 'Hydraulic Fluid, Rust Inhibited, Fire Resistant, Synthetic Hydrocarbon Base'.** M. E. Le Pera (U.S. Army, Research and Mobility Equipment and Development Command, Fort Belvoir, Va.), J. Messina (U.S. Army, Pitman-Dunn Research Laboratories, Frankford Arsenal, Philadelphia, Pa.), H. Mullinger (Chrysler Corp., Highland Park, Mich.), and C. E. Snyder (USAF, Material Laboratory, Wright-Patterson AFB, Ohio). *American Society of Lubrication Engineers, Annual Meeting, 32nd, Montreal, Canada, May 9-12, 1977, Preprint 77-AM-2A-1*. 6 p. 8 refs.

A77-36024 **Determination of SO2 concentrations from a coal-burning power plant stack by Fourier spectrometry.** L. H. Tanabe (General Dynamics Corp., Pomona, Calif.) and W. F. Herget (U.S. Environmental Protection Agency, Washington, D.C.). In:

Modern utilization of infrared technology II: Civilian and military; Proceedings of the Seminar, San Diego, Calif., August 26, 27, 1976. (A77-36014 16-35) Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1976, p. 66-73. U.S. Environmental Protection Agency Contract No. 68-02-1804.

A77-36026 A multigas analyzer for automobile exhausts. J. D. Pembrook and D. E. Burch (Ford Aerospace and Communication Corp., Aeronutronic Div., Newport Beach, Calif.). In: Modern utilization of infrared technology II: Civilian and military; Proceedings of the Seminar, San Diego, Calif., August 26, 27, 1976. (A77-36014 16-35) Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1976, p. 84-91.

The multigas analyzer simultaneously measures the concentrations of CO, CH4 and CO2 in flowing samples of automobile exhaust. Three channels share a single rotating gas correlation cell and measure the individual concentrations of CO and CH4. Two CO channels with different sample cell lengths extend the useful range. A rotating dual-filter system measures the CO2 concentrations. As many as three separate CO2 channels can share a rotating filter assembly. A system employing two fixed filters and two detectors measures the concentration of H2O and automatically accounts for a slight interference by this gas in the CH4 channel. An automatic gain control minimizes calibration drift. The ranges of measurable concentrations are 0.3 ppm (parts-per-million) to 3000 ppm of CH4; 0.7 ppm to 10% of CO; and 60 ppm to 30% of CO2, where the minimum concentrations correspond to the peak-to-peak noise levels with one-second time constants. (Author)

A77-36049 Solar energy prospects grow for US southwest. E. J. Jeffs. *Energy International,* vol. 14, June 1977, p. 17-21, 32.

In connection with the disappearance of oil and gas, the traditional energy sources of the region, there appears to be every incentive to develop solar energy for domestic and industrial use in the U.S. Southwest. The various approaches for the utilization of solar energy are discussed, taking into account its direct application to water and space heating and to air conditioning, the generation of electricity with the aid of photovoltaic principles or by means of electric generators driven by steam obtained with solar energy, and the indirect collection of solar energy in the form of biomass. Attention is given to flat plate collectors for houses, advantages of a use of liquid sodium in solar tower systems, and the distributed collector system. G.R.

A77-36050 China claims lead in biogas energy supply. V. Smil (Manitoba, University, Winnipeg, Canada). *Energy International,* vol. 14, June 1977, p. 25-27.

First attempts to produce biogas in China were made during the time from 1958 to 1960. A successful adoption of biogasification methods occurred more than a decade later. Peasants in the Szechwan Basin built the first few hundred digesters with local rocks and lime during the period from 1970 to 1972. It has now been reported that more than 1.3 million digesters were built in Szechwan during the first six months of 1976. The primary use of biogas throughout the country is for household cooking and lighting. Biogas is also employed for fueling water pumps, farm processing machinery, and generating sets. Details of digester design and operation are discussed. G.R.

A77-36088 # Investigation of the Hall effect in the plasma of an inductive high-frequency discharge (Issledovanie effekta Kholla v plazme induktsionnogo vysokochastotnogo razriada). A. P. Zhilinskii, B. V. Kuteev, and A. S. Smirnov (Leningradskii Politekhnicheskii Institut, Leningrad, USSR). *Pis'ma v Zhurnal Tekhnicheskoi Fiziki,* vol. 3, Mar. 26, 1977, p. 258-261. In Russian.

The paper considers the development of an efficient MHD generator with nonequilibrium conductivity which uses inductive HF discharges. Experiments were conducted to study the Hall effect for this type of discharge in argon at pressures of 15 and 32 torr with an additive of cesium. It is shown that an inductive-discharge plasma has high stability with respect to the development of different kinds of plasma oscillations for the case of MHD generator-plasma parameters. B.J.

A77-36097 # Two-dimensional analysis of end effects in diagonal type nonequilibrium plasma MHD generator. M. Ishikawa and J. Umoto (Kyoto University, Kyoto, Japan). *Kyoto University, Faculty of Engineering, Memoirs,* vol. 38, Oct. 1976, p. 182-197. 7 refs.

The effects on the current distribution and related factors of the arrangement of the output electrodes and of attenuation of magnetic induction were investigated in two dimensions in the end regions of the diagonal-type nonequilibrium plasma MHD generator. It is shown that the eddy current in the end regions of the generator can almost be nullified by a proper distribution of magnetic induction and a suitable arrangement of output electrodes, and that various arrangements of the output electrodes have little influence on the current distribution and related factors. M.L.

A77-36104 Solar energy and energy storage (Energie solaire et stockage d'énergie). R. Dumon (Heurtey, S.A., Paris, France). Paris, Masson et Cie., Editeurs, 1977. 143 p. 62 refs. In French. $15.20.

The centrality of the problem of storage of solar energy to cope with day/night alternation, inclement weather, and cloudiness or cloud passages that render solar energy input variable and unpredictable is addressed, and advances in energy storage pertinent to large-scale solar energy use are reviewed. Energy storage in general, storage of nuclear energy and solar energy in particular, and problems specific to solar energy storage are covered. Modes of energy storage discussed include: hydraulic pumping, pressurized vapor, batteries, compressed air, inertial storage, electromagnetic storage, electrochemical batteries, hydrogen storage, and thermal storage. Varieties of heat storage facilities for different temperature ranges are discussed. Photosynthesis, corrosion, and various heat-transfer media are dealt with. R.D.V.

A77-36114 A comparison of residential and commercial energy use in the United States and Sweden. A. J. Lichtenberg and L. Schipper (California, University, Berkeley, Calif.). *Energy and Buildings,* vol. 1, May 1977, p. 89-92.

The differences between the U.S. and Sweden in residential and commercial energy use are discussed in terms of energy efficiencies. The lower Swedish per capita energy consumption in these sectors is principally explained by these factors: (1) better insulation and construction standards in buildings to give considerably higher overall heating efficiencies, (2) more realistic commercial lighting standards, and (3) significant differences in residential end-use devices and end-use choices. Also centralized water heating systems and the practice of district heating contribute to Sweden's more efficient usage of residential and commercial energy. (Author)

A77-36124 Comparative breeding characteristics of fusion and fast reactors. P. Fortescue (General Atomic Co., San Diego, Calif.). *Science,* vol. 196, June 17, 1977, p. 1326-1329.

Expressions are developed to allow ready comparison of a hybrid fission-fusion plant and a fast breeder with respect to the number of thermal reactors that their fissile production could support, both for their feed requirements and for the new inventory needs of an expanding industry. These relations are expressed in terms of the neutron multiplication factor obtained in the fusion blanket, and the analogous quantities represented by the conversion ratios of the fast and thermal fission associated with the comparison. Results are presented graphically both for the steady state and for industries of arbitrary growth rate, and include the influence of tritium production requirements. Even a modest blanket neutron multiplication factor could enable the hybrid fusion system greatly to outperform the fast breeder on this simple basis of material balances. (Author)

A77-36127 **Sewage sludge treatment and disposal.** R. W. James. Park Ridge, N.J., Noyes Data Corp. (Pollution Technology Review, No. 29), 1976. 350 p. $39.

Sludge oxidation processes are considered along with sludge dewatering processes, the use of flocculants, nitrate and phosphate removal, and approaches for obtaining fertilizers from sludge. Questions related to incineration are considered, taking into account the nozzle feed system, pressure-cooked sludge as feed, the cascade addition of sludge, a secondary bed elutriation arrestor labyrinth construction, aspects of distributor plate arrangement, and a multi-stage dryer above the furnace. Miscellaneous processes are discussed, giving attention to a compact mechanical treatment for small ships, refinery waste sludge treatment, the conversion of sludge to synthesis gas, and the addition of powdered coal to control odor. G.R.

A77-36157 **A new series of aerofoil sections suitable for aircraft propellers.** A. J. Bocci (Aircraft Research Association, Ltd., Bedford, Beds., England). *Aeronautical Quarterly*, vol. 28, Feb. 1977, p. 59-73. 6 refs.

A series of advanced aerofoil sections suitable for aircraft propellers has been developed. The sections combine advanced supercritical flow characteristics with good low-speed performance and are also directly applicable to other rotating aerodynamic machinery, such as low-solidity ducted fans, windmills, etc. The work has focused initially on propeller sections of around 6 per cent thickness/chord ratio, typical of the fundamental blade station where peak loading is usually carried (0.7 x radius). The complete section family covers a wide range of thickness/chord ratios, from 3 per cent to over 20 per cent. The profiles are defined by mathematical formulae and distort with thickness to achieve a shape having optimum performance characteristics at the flow conditions expected for that thickness. A subset of the family is defined for higher Mach number penetration, up to near sonic values. (Author)

A77-36242 **A parametric analysis of the structure of international energy consumption.** A. Le Mehaute (Lyon, Ecole Supérieure de Chimie Industrielle, Villeurbonne, Rhône, France) and A. J. Appleby (CNRS, Laboratoire d'Electrolyse, Meudon, Hauts-de-Seine, France). *Energy* (UK), vol. 2, June 1977, p. 105-114.

A mathematical analysis of the hierarchic structure of complex organized entities is given. It is shown that the structure of energy consumption and GNP per inhabitant in the countries with market economies follows such a model with high precision. Two classes of parameters are discernible, which permit a definition of rich and peripheral nations. The parameters defining the hierarchic structure (i.e. the degree of interdependence of nations) are time-dependent for energy, though apparently not for GNP. These factors have an important part to play in predicting future trends in energy consumption and GNP. (Author)

A77-36243 **Energy and the economy - An interrelated perspective.** J. H. Krenz (Colorado, University, Boulder, Colo.). *Energy* (UK), vol. 2, June 1977, p. 115-130. 20 refs.

The monetary cost of energy-related capital investments which can reduce energy inputs and the energy required to produce these capital goods are discussed. It is pointed out that more effective energy utilization may be accomplished through a combination of social changes and energy-related capital investments. Attention is given to energy and economic projections, an international perspective, U.S. energy intensiveness, input-output accounts, consumer goods and services, the new construction sector, and energy consumption and capital investment. G.R.

A77-36244 **Historical patterns of residential and commercial energy uses.** E. Hirst and J. Jackson (Oak Ridge National Laboratory, Oak Ridge, Tenn.). *Energy* (UK), vol. 2, June 1977, p. 131-140. 16 refs. Research supported by the Federal Energy Administration and ERDA.

This paper reviews trends in residential energy use and commercial energy use for the 1950-75 period. Historical data on energy use by type of fuel - electricity, gas, oil, other - are presented for both sectors. These energy use data are compared with data on the determinants of energy use for each sector: population, per capita income, fuel prices, economic output from the service sectors, commercial building floorspace. These historical data show marked differences between the 1950-72 and 1972-75 periods. From 1950 to 1972, energy use in both sectors grew steadily and rapidly. Since 1972, however, energy use growth has been almost static and unstable. The data show, in a general way, the influence of changes in fuel prices and economic activity on energy use. (Author)

A77-36245 **A simple model for solar energy economics in the U.K.** P. T. Landsberg (Southampton, University, Southampton, England). *Energy* (UK), vol. 2, June 1977, p. 149-159. 13 refs.

Questions concerning the suitable financial support of solar energy research and development in the UK are considered. An approach is discussed for estimating minimum efficiencies for the economic viability of solar energy conversion by thermal or photovoltaic means. Equations are provided concerning the maximum annual outlays on research, development, and construction permitted by considerations of economic viability. The investigation is limited to questions of economics in which solar energy conversions are regarded as complementing other sources of energy. G.R.

A77-36254 * **Thermal alteration experiments on organic matter from recent marine sediments in relation to petroleum genesis.** R. Ishiwatari, M. Ishiwatari, B. G. Rohrback, and I. R. Kaplan (California, University, Los Angeles, Calif.). *Geochimica et Cosmochimica Acta*, vol. 41, June 1977, p. 815-828. 41 refs. Grant No. NGR-05-007-221; Contract No. E(04-3)-34.

Three fractions of organic matter: lipid (benzene:methanol-extractable), humic acid (alkali-extractable) and kerogen (residue) were extracted from a young marine sediment (Tanner Basin, offshore southern California) and heated for different times (5-116 hr) and temperatures (150-410 C). The volatile (gases) and liquid products, as well as residual material, were then analyzed. On a weight basis, the lipid fraction produced 58% of the total identified n-alkanes, the kerogen fraction 41%, and the humic acid less than 1%. The volatiles produced by heating the lipid and humic acid fractions were largely CO2 and water, whereas those produced from heated kerogen also included methane, hydrogen gas and small amounts of C2-C4 hydrocarbons. A mechanism for hydrocarbon production due to the thermal alteration of organic constituents of marine sediment is discussed. (Author)

A77-36263 # **The sawtooth coverslide - A new means of coupling light into solar cells.** A. Meulenberg, Jr. (Comsat Laboratories, Clarksburg, Md.). *Journal of Energy*, vol. 1, May-June 1977, p. 151-154. 25 refs. Research sponsored by the Communications Satellite Corp.

In recent years major improvements have been made in silicon solar cell output by increasing the per cent of incident light that actually penetrates into the active volume of the cell through the use of shallow junctions, p(+) back contacts, new antireflection coatings, and etched front surfaces. A new coverslide design described herein reduces the reflection from coverslide surfaces and redirects the light to fall only between the grids, thus increasing the effective area of the cell. With all of these improvements combined, the light collection capability of a solar cell assembly is close to the maximum value possible without using external light concentrators. (Author)

A77-36264 # **On the feasibility of small power satellites.** K. E. Drexler and T. A. Heppenheimer. *Journal of Energy*, vol. 1, May-June 1977, p. 200. 7 refs.

A major problem concerning the development of the solar power satellite is realted to the large size of the most commonly studied concepts. Thus, there is considerable interest in the develop-

ment of pilot-plant or demonstration powersats. Difficulties concerning the implementation of a subscale application of pertinent technologies exist, however, in connection with the transmitting antenna. These difficulties can possibly be overcome by making use of the Power Relay Satellite proposed by Ehricke (1974). G.R.

A77-36272 Decision making in the utilisation of the organic fraction of municipal wastes. I. J. Miller (Department of Scientific and Industrial Research, Chemistry Div., Petone, New Zealand). *New Zealand Journal of Science,* vol. 19, Dec. 1976, p. 339-344. 6 refs.

An outline of processes available that could utilize refuse and an estimate of the distribution and composition of refuse in New Zealand are given. A procedure for decision making is applied to the New Zealand situation. Ethanol production and slagging pyrolysis appear to be the most favorable processes within the frame of current prices and anticipated technology assumed. (Author)

A77-36279 Operation results of the desulfurization plant for a thermal power station. Y. Yoshimizu (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan). *IHI Engineering Review,* vol. 10, Apr. 1977, p. 95-100.

A description is presented of a desulfurization plant with a gas-processing capacity of 450,000 N cu m/hr. The plant was installed in the Niihama Nishi Power Station in Japan. The plant uses the limestone wet scrubbing and gypsum recovery method. More than 90% of the sulfur are removed. Attention is given to a number of tests and operational studies which were conducted to ensure the efficiency of SOx removal and the safety and stability of operation, taking into account the employment of a high-sulfur heavy oil as fuel. G.R.

A77-36284 Energy storage, compression, and switching. Edited by W. H. Bostick (Stevens Institute of Technology, Hoboken, N.J.), V. Nardi (Istituto Elettrotecnico Nazionale Galileo Ferraris, Turin, Italy; Stevens Institute of Technology, Hoboken, N.J.), and O. S. F. Zucker (California, University, Livermore, Calif.). New York, Plenum Press, 1976. 548 p. $39.50. (For individual items see A77-36285 to A77-36322).

Attention is given to electron beam generators, imploding systems for controlled fusion, plasma focus and collective effects, inductive and capacitative storage systems, and switches (semiconductor, triggered spark gap, etc.). Particular papers are presented on a 2 MV coaxial Marx generator for producing intense relativistic electron beams, a multi-megajoule inertial-inductive energy storage system, explosively driven MHD generator systems, adiabatic compression of plasma vortex structures, the magnetic energy storage system used in ZT-1, pulsed fusion, and recent advances in three electrode field enhanced triggered gas switches. B.J.

A77-36292 A multi-megajoule inertial-inductive energy storage system. A. E. Robson, P. Turchi, W. Lupton, M. Ury, and W. Warnick (U.S. Navy, Naval Research Laboratory, Washington, D.C.). In: Energy storage, compression, and switching. (A77-36284 16-75) New York, Plenum Press, 1976, p. 95-103. 22 refs.

An inertial-inductive energy storage system is described, made up of modules each storing, nominally, ten megajoules. The energy in each module is stored initially in two counter-rotating flywheels which are arranged inside an air-cored inductor to form a self-excited homopolar generator. The storage inductor is also the primary of an air-cored transformer; the primary circuit is broken by a pressured SF6 circuit breaker, commutated by a circuit containing a capacitor and a fuse. The function of the fuse is to disconnect the commutating circuit after if has performed its function and thereby minimize the size of the commutating capacitor. The output of the system is taken from the secondary of the transformer, and will be used to drive imploding liners as part of the LINUS program. The rationale of this approach is discussed and the prototype module is described. (Author)

A77-36300 Explosively driven MHD generator power systems for pulse power applications. J. Teno and O. K. Sonju (Maxwell Laboratories, Inc., Woburn, Mass.). In: Energy storage, compression, and switching. (A77-36284 16-75) New York, Plenum Press, 1976, p. 151-156. ARPA-USAF-supported research.

Explosively driven MHD generators offer one means of generating very large bursts of energy directly without the requirement for switching. Since switches for systems using conventional techniques for generating very high energy bursts are not presently available, this feature is very significant. In an explosively driven MHD generator, a high enthalpy plasma is generated by detonating an explosive charge in a containment chamber; this plasma as it is formed is directed toward the channel and expanded at the same time. As the plasma moves through the generator channel cutting a magnetic field at very high speeds, it generates a high energy pulse. This paper reports the results of a preliminary investigation of explosively driven MHD generators. The work performed was both of an analytical and experimental nature including studies of explosives, detonators, expansion of detonation products and evaluation of conductivity of expanded gases resulting from detonation of explosive charges. The results of this work provides a sound foundation for continuing explosively driven MHD generator research and development programs. (Author)

A77-36309 Superconductivity, energy storage and switching. H. L. Laquer (California, University, Los Alamos, N. Mex.). In: Energy storage, compression, and switching. (A77-36284 16-75) New York, Plenum Press, 1976, p. 279-305. 84 refs. ERDA-sponsored research.

An investigation is conducted concerning the possibility to utilize superconductivity for applications related either to inductive energy storage and energy transfer or to switching, taking into account the basic physical characteristics of superconductivity, technological switching considerations, the currently available hardware, and economic evaluations. It is concluded that on a capital cost basis superconductivity-employing energy-storage systems with capacities of less than 50 MJ are currently not competitive with other types of energy-storage systems. However, the situation changes for very high energies where overall efficiency becomes of paramount importance. Superconducting switching applications may be feasible for selected cases. Current cost relations concerning superconductive applications will possibly change in the future with the further development of the corresponding technology. G.R.

A77-36311 The design, fabrication and testing of a five megajoule monopolar motor-generation. W. F. Weldon, M. D. Driga, H. H. Woodson, and H. G. Rylander (Texas, University, Austin, Tex.). In: Energy storage, compression, and switching. (A77-36284 16-75) New York, Plenum Press, 1976, p. 325-335. Research supported by the Texas Atomic Energy Research Foundation, Electric Power Research Institute, and AEC.

A description is presented of a Faraday Disk or homopolar machine which can be used as an energy storage system to provide the large quantities of electric power needed for short periods of time for confinement and/or heating of the plasma in future thermonuclear fusion experiments. A use of the considered energy-storage systems makes it possible to reduce the cost of energy storage considerably in comparison to currently employed energy storage devices. Basic limitations of the homopolar machine related to some complex design features have been overcome with the aid of a design which utilizes conventional technology. G.R.

A77-36314 The magnetic energy storage system used in ZT-1. L. C. Burkhardt, R. Dike, J. N. Di Marco, J. A. Phillips, R. Haarman, and A. E. Schofield (California, University, Los Alamos, N. Mex.). In: Energy storage, compression, and switching. (A77-36284 16-75) New York, Plenum Press, 1976, p. 351-354.

The ZT-1 toroidal pinch experiment is driven by a magnetic energy storage system that uses four fuses to interrupt the current. One fuse package can interrupt 800 kA, develop 70 kV peak, and

absorb 30 kJ. Each quadrant is driven by a fuse to increase the total voltage around the torus to 280 kV and the total inductively stored energy is 100 kJ. Approximately 10% agreement is obtained with a numerical calculation used to predict the fuse behavior. Inductive coupling of 14 nH between the four fuses eliminates the jitter of about 0.1 microsec, observed with a single fuse. (Author)

A77-36318 Laser fusion - Capital cost of inertial confinement. R. E. Kidder (California, University, Livermore, Calif.). In: Energy storage, compression, and switching. (A77-36284 16-75) New York, Plenum Press, 1976, p. 377-379. ERDA-sponsored research.

In the context of laser-induced fusion of solid pellets, a quadratic relation between peak laser power and the inertial confinement parameter is derived and discussed. This relation is combined with the linear relation between laser system cost and peak output power to obtain an estimate of the capital cost of inertial confinement. (Author)

A77-36326 Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. Symposium sponsored by the American Chemical Society. Edited by A. H. Pelofsky (Cities Service Research and Development Co., Cranbury, N.J.). New York, Marcel Dekker, Inc., 1977. 484 p. $35. (For individual items see A77-36327 to A77-36346)

The economics of crude oil and natural gas are considered along with an economic evaluation by ERDA of alternative fossil energy technologies, an economic comparison of synthetic fuels, the relative advantages of coal conversion routes for electric power generation, economic data for a 50,000 BDP Lurgi/Ruhrgas shale oil plant, and an evaluation of an in-situ coal gasification concept. Attention is also given to clean energy from Alaskan coals, the flash hydropyrolysis process for conversion of lignite to liquid and gaseous products, fuel gas production via Koppers-Totzek gasification, Winkler technology for clean fuels from coal, and the economics of ethylene production via pyrolysis of coal-based Fischer-Tropsch hydrocarbons. G.R.

A77-36327 Economics of crude oil and natural gas - Cost of adding production. R. C. Sparling (Chase Manhattan Bank, North America, New York, N.Y.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 1-12.

U.S. petroleum industry finding and development expenditures are examined along with the drilling effort reported for the time from 1952 to 1974. It is found that in the last two years, almost as much footage was drilled for gas as was drilled for oil. Attention is given to crude oil production and reserves, nonassociated natural gas production and reserves, and figures concerning the capital expenditures for oil business and gas business. It is pointed out that the petroleum industry supplies about 75% of all the energy in the U.S. and that it will continue to be the principal supplier in the forseeable future. The petroleum and the coal industries are the only ones with any chance to expand rapidly enough to meet the short term needs of this nation. G.R.

A77-36328 Economic evaluation by ERDA of alternative fossil energy technologies. M. R. Adams, C. W. Knudsen, and C. W. Draffin (ERDA, Office of Program Planning and Analysis, Washington, D.C.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 13-37.

After explaining the economic criteria and methodology which the Energy Research and Development Administration is developing to evaluate fossil energy technologies, this paper considers the role and preliminary results of process economic comparisons. Implications of preliminary cost estimates of high-Btu gasification and liquefaction processes and sensitivities are explored. Analysis indicates the projected product selling prices are greatly affected by the method of financing and raw material costs. Also examined are potential impacts of reduction in capital requirements, determination of coal feedstock specifications, reliability, transportation and distribution of coal conversion products, and modification of liquefaction product specifications. (Author)

A77-36329 Economic comparison of synthetic fuels - Gasification and liquefaction. S. Katell and L. G. White (U.S. Bureau of Mines, Process Evaluation Group, Morgantown, W. Va.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 39-64.

One of the processes considered in the reported investigation is the Synthane process. Synthane is a process to convert bituminous and subbituminous coal and lignite to a high-Btu substitute pipeline gas. Free-fall carbonization plus steam-oxygen gasification of the pretreated coal in a fluidized bed is employed. Another process step involves the shift conversion of the gasifier synthesis gas to a H2:CO ratio of 3:1. The ultimate step is concerned with the catalytic methanation of the gas. A second process, called the Synthoil process, involves a fluid-phase hydrogenation of coal for the production of a low-sulfur heavy fuel oil. The Synthoil system can handle any type of coal and is being developed for the pilot plant phase. The economic analysis conducted shows that the costs for producing synthetic fuels are high in comparison with present energy prices. G.R.

A77-36330 The relative advantages of coal conversion routes for electric power generation. E. Interess, S. A. Reber, and R. P. Stickles (Arthur D. Little, Inc., Cambridge, Mass.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 65-78. 6 refs.

An investigation is conducted concerning the relative positions of some of the competing technologies from the standpoint of ultimate economics of large-scale (1000 MW) installations. It is found that advanced power systems now under development appear to have only slight potential advantage over conventional steam/electric generation with flue gas desulfurization. Beyond 1985 it is probable that further improvements in advanced system designs will improve the overall reliabilities of the advanced power systems. Dispersed fuel cells appear to have the most promise in the intermediate load range. Gas turbines based on coal-derived distillates are attractive in the peak load range. G.R.

A77-36331 Economic data for a 50,000 BPD Lurgi/Ruhrgas shale oil plant. P. Marnell (American Lurgi Corp., Hasbrouck Heights, N.J.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 79-105.

The reported investigation is concerned with the economic data regarding the use of the Lurgi-Ruhrgas (LR) process in connection with the processing of oil shales. A description is presented of the LR process as applied to the distillation of oil shale. The advantages of the LR process are examined, taking into account process advantages and economic consequences. The data for a LR shale retorting section are discussed. Attention is given to the actual hourly material flows, the key properties of the product oil and gas streams, and the investment cost data for a completely erected LR retorting section. G.R.

A77-36332 Evaluation of the Lawrence Livermore Laboratory in-situ coal gasification concept. R. Z. Mason (Williams Brothers Process Services, Inc., Tulsa, Okla.), C. S. Goddin (Amoco Production Co., Tulsa, Okla.), and D. E. Hall (Pacific Gas and Electric Co., San Francisco, Calif.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 107-141. 8 refs.

The considered concept involves the drilling of blastholes into a coal bed located at 500 to 3000 foot depth, the detonation of chemical slurry explosive to create permeability, the injection of oxygen and steam into the top of the fractured coal bed, and the removal of the gasification products via wells completed to the bottom of the bed. The study indicates that the pipeline gas from the in situ gasification process would be cost competitive with that from Lurgi gasification of strip-mined coal if operability of the in situ gasification process can be demonstrated with 70% sweep efficiency. G.R.

A77-36333 *Clean energy from Alaskan coals.* S. M. Kohan (Stanford Research Institute, Menlo Park, Calif.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 143-162.

A description is presented of an investigation which was to determine the economic feasibility of operating a coal conversion facility in Alaska utilizing the large Beluga coal reserves. The Beluga coal fields lie about 60 air miles west of Anchorage, Alaska, on the northwest side of the Cook inlet. A solvent refined coal process designed to produce 100,000 barrels per day of total liquids is considered. Attention is given to aspects of coal mining, coal conversion, the process material balance, and questions of transportation. G.R.

A77-36334 **Flash hydropyrolysis process for conversion of lignite to liquid and gaseous products.** M. Steinberg, T. V. Sheehan, and Q. Lee (Brookhaven National Laboratory, Upton, N.Y.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 163-192. 16 refs. ERDA-sponsored research.

It is pointed out that the direct noncatalytic flash hydropyrolysis of coal tends to maximize liquid aromatic (benzene) as well as other liquid hydrocarbon product yields. Experimental results are considered as a basis for the process design. Details of reactor design are discussed along with problems of overall process design and questions of process profitability. It is concluded that the flash hydropyrolysis process offers flexibility in either production of aromatic and olefinic chemical feedstocks or unleaded gasoline production from coal. Economic estimates indicate that the process approaches the limit which will permit a reasonable rate of return for venture capital. G.R.

A77-36335 **The IGT low-Btu gas process - Design and economics.** J. G. Patel, K. B. Burnham, and J. W. Loeding (Institute of Gas Technology, Chicago, Ill.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 193-214. 7 refs.

The Institute of Gas Technology is developing a process to produce a clean, low-Btu (150 to 300 Btu/SCF) fuel gas from coal. The process utilizes a single-stage fluidized bed gasifier operating at moderate pressure (100 to 350 psi) and high temperatures (1800 to 2000 F). This paper describes a preliminary process design for an air-blown plant that would feed 5000 tons-per-day of agglomerating high-sulfur-content Illinois Basin coal, producing a low-Btu fuel gas with a heating value of 161 Btu/SCF, for a daily equivalent yield of 95 billion Btu. The total plant investment is estimated to be $155 million in mid-1975 U.S. dollars, and the product gas price, using $15/ton coal cost, is $2.01 per million Btu. The overall process efficiency for conversion of coal to fuel gas plus by-products is 84%. The experimental work upon which the process design was based is reported; and the process, as well as all major plant units, is described. (Author)

A77-36336 **Fuel gas production via Koppers-Totzek gasification - An economic analysis.** H. J. Michaels and J. F. Kamody (Koppers Co., Inc., Pittsburgh, Pa.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 215-250. 7 refs.

The Koppers-Totzek (K-T) process has been used for the commercial gasification of coal in the Eastern Hemisphere since 1952. The gas produced by the K-T process is rich in CO and hydrogen. The gas has a gross heating value of 300 Btu per cubic foot and is suited for industrial fuel, direct ore reduction, or chemical synthesis applications. The national importance of coal gasification is examined and the capital requirements for a K-T fuel gas plant are considered. Attention is given to the effect of financial and operating variables on cost, the effects of price inflation and escalation on fuel costs, and the incentives needed to implement coal gasification. It is found that, as a result of current price trends concerning natural gas, the cost of energy from existing K-T gasification facilities will within a relatively short period of time be less than that of alternate sources. G.R.

A77-36337 **Winkler technology for clean fuels from coal.** J. H. Marten, I. N. Banchik, and T. K. Subramanian (Davy Powergas, Inc., Lakeland, Fla.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 251-285.

The Winkler process for the gasification of coal has been in successful commercial operation since the middle 1920s. In the fluid bed of the gasifier coal reacts with a mixture of air or oxygen and steam. The gas leaving the gasifier is only a mixture of H2, CO, CO2, N2, and CH4. The basic process is discussed along with the heat and material balances and the advantages of the Winkler system. A description is provided of the pressurization of the Winkler process for the production of clean fuel from coal. Attention is given to the necessity for process pressurization, the processing steps, aspects of gas cooling and particulate removal, desulfurization, and sulfur recovery. G.R.

A77-36338 **Preliminary economic analysis - Oil and power by COED-based coal conversion.** J. B. O'Hara and R. V. Teeple (Ralph M. Parsons Co., Pasadena, Calif.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 287-318. ERDA-supported research.

A conceptual design and an economic evaluation has been prepared for a commercial complex to mine approximately 36,000 tons per day of high-sulfur coal and produce low-sulfur synthetic crude oil, electrical energy, and sulfur using COED-based pyrolysis technology for the coal conversion portion of the complex. COED is a multistep low-pressure coal pyrolysis process. It produces a gas, a liquid, and a significant amount of char. A facility description is presented and an economic analysis is conducted. G.R.

A77-36339 **Economics of ethylene production via pyrolysis of coal based Fischer-Tropsch hydrocarbons.** G. M. Drissel (Air Products and Chemicals, Inc., Allentown, Pa.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 319-331.

Typical analyses of Fischer-Tropsch reaction products are presented in a table, taking into account products obtained with the aid of two reactors. Yield distributions obtained from numerous sources for the pyrolysis of hydrocarbons to ethylene are listed in a second table and a conceptual flow diagram is provided for ethylene via Fischer Tropsch hydrocarbon pyrolysis. Attention is given to ethylene plant investment data, by-product credit rates for ethylene plants, the design of a dispersed phase fluid bed reactor, and annual operating costs. G.R.

A77-36340 **Comparative economics for the Arthur D. Little extractive coking process.** S. A. Reber, R. M. Nadkarni, and R. W. Hyde (Arthur D. Little, Inc., Cambridge, Mass.). In: Synthetic

fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 333-355. 13 refs. ERDA-sponsored research.

General aspects concerning coal liquefaction processes are considered and a process description is provided, taking into account delayed coking technology, the ADL extractive coking process, and questions concerning the yield structure. Attention is given to the commercial design for a preliminary economic analysis, the extraction/coking cycle, a preliminary economic analysis, a comparison with other processes, and the current status of experimentation. G.R.

A77-36341 Economics of synthetic gas production by the SEGAS process. M. S. Newkirk (International Materials Corp., Burlington, Mass.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 357-374.

The considered process is employed for the gasification of residual high-sulfur fuel oils or heavy crudes to obtain a high synthesis gas product which can be used as a petrochemical intermediate or as a high-grade fuel gas. The SEGAS process is a noncatalytic process. A thermal steam reformation mechanism is employed. No oxygen or air injection is required. The economic reasons underlying the current interest in heavy oil gasification are examined and an economic analysis of the commercial scale SEGAS process is conducted. G.R.

A77-36342 Technology and economics of industrial fuel gas from coal. E. J. Ferretti (Dravo Corp., Pittsburgh, Pa.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 375-395.

The applications for an industrial fuel gas manufactured from coal are considered, taking into account the manufacture of steel and aluminum, the production and processing of glass and ceramics, the manufacture of lime and cement, the manufacture of bricks, uses for the petrochemical industry, and an employment as fuel for boilers to generate steam or electrical power. Considerations related to the design of an industrial fuel gas project are discussed and features of gasification technology are examined. Attention is given to the estimated cost for producing an environmentally clean industrial fuel gas. G.R.

A77-36343 A comparison of operational economics of transportation vehicles operated on gasoline and coal-generated hydrogen. R. E. Billings (Billings Energy Research Corp., Provo, Utah). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 397-417. 18 refs.

An investigation is conducted concerning the vehicle operational costs for a 350-vehicle taxi fleet and a 100-vehicle bus fleet. The historical background regarding hydrogen engines is reviewed. Problems of hydrogen storage are examined, taking into account the possibility to make use of metal hydrides. Attention is given to engine efficiency, aspects of air pollution, the efficiency of existing energy resource utilization, economics, and safety. The investigation shows that coal-generated hydrogen does have potential as a vehicular fuel for transportation. The best area for early implementation of the fuel is in fleet vehicles. G.R.

A77-36344 * Efficiency and cost advantages of an advanced-technology nuclear electrolytic hydrogen-energy production facility. T. D. Donakowski, W. J. D. Escher, and D. P. Gregory (Institute of Gas Technology, Chicago, Ill.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 421-433. 10 refs. Contract No. NAS8-30757.

The concept of an advanced-technology (viz., 1985 technology) nuclear-electrolytic water electrolysis facility was assessed for hydrogen production cost and efficiency expectations. The facility integrates (1) a high-temperature gas-cooled nuclear reactor (HTGR) operating a binary work cycle, (2) direct-current (d-c) electricity generation via acyclic generators, and (3) high-current-density, high-pressure electrolyzers using a solid polymer electrolyte (SPE). All subsystems are close-coupled and optimally interfaced for hydrogen production alone (i.e., without separate production of electrical power). Pipeline-pressure hydrogen and oxygen are produced at 6900 kPa (1000 psi). We found that this advanced facility would produce hydrogen at costs that were approximately half those associated with contemporary-technology nuclear electrolysis: $5.36 versus $10.86/million Btu, respectively. The nuclear-heat-to-hydrogen-energy conversion efficiency for the advanced system was estimated as 43%, versus 25% for the contemporary system. (Author)

A77-36345 The economics of industrial process heat from solar energy. W. C. Dickinson (California, University, Livermore, Calif.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 435-441.

The allowed costs for cost-competitive solar systems are considered, taking into account the economic parameters for a typical industrial process heat system. It is pointed out that the allowed total solar system cost will rise in connection with increases in the price of fuel oil. A description is presented of the ERDA-SOHIO industrial process heat project involving a large area, low-cost type of solar collector, the shallow solar pond. An experimental solar water-heating facility is to be built for a new uranium mining and milling plant, located about 50 miles west of Albuquerque, New Mexico. Attention is also given to the prospects for industrial process steam from solar energy. G.R.

A77-36346 Economic feasibility of the conversion of organic waste to fuel oil and pipeline gas. E. Del Bel, S. Friedman, and P. M. Yavorsky (ERDA, Pittsburgh Energy Research Center, Pittsburgh, Pa.). In: Synthetic fuels processing: Comparative economics; Proceedings of the Symposium, New York, N.Y., April 4-9, 1976. (A77-36326 16-44) New York, Marcel Dekker, Inc., 1977, p. 443-459. 14 refs.

Current estimates indicate that approximately 130 million tons of municipal solid waste are generated in the United States each year. Combustion, pyrolysis, fermentation, gasification, and liquefaction have been proposed as practicable methods for the utilization of this material which has an energy equivalent of 150 million barrels of oil and contains about 20 million tons of metals and glass. The Pittsburgh Energy Research Center (ERDA) has been involved in the development of processes for the conversion of organic wastes to fuel oil, and pipeline gas. In the liquefaction process, the refuse is converted to fuel oil by reaction with carbon monoxide, or synthesis gas, and steam at 3,000 psi and 350-400 C. Pipeline quality gas is made from organic waste by hydrogasification at 1,000 psi and 650-800 C. The economic feasibility of these two processes as applied to municipal solid waste (MSW) and cattle manure is discussed. (Author)

A77-36347 Ground water as energy carrier (Das Grundwasser als Energieträger). K.-D. Balke (Tübingen, Universität, Tübingen, West Germany). *Brennstoff-Wärme-Kraft*, vol. 29, May 1977, p. 191-194. 14 refs. In German.

The utilization of the ground water as energy carrier in connection with the employment of heat pumps is discussed from the hydrogeological point of view. The ground water temperatures in regions of great population density are considered, taking into account a map indicating the water temperatures in the Cologne area in Germany at a depth of 0.5 m below the ground water level. Hydrochemical and hydrobiological effects of ground water temperature rises are examined and questions related to the use of ground

water as waste heat carrier are explored. Attention is given to a thermal balance study which makes it possible to arrive at an estimate concerning the long-term possibilities for obtaining energy from ground water. G.R.

A77-36348 The question of the utilization of geothermal energy in dry rocks /dry walls/ (Zur Frage der Nutzung geothermischer Energie in trockenen Gesteinsmassen /Trockenwände/). V. Knapp and E. Coffou (Zagreb, Sveuciliste, Zagreb, Yugoslavia). *Brennstoff-Wärme-Kraft,* vol. 29, May 1977, p. 195-198. 7 refs. In German.

The utilization of the heat energy contained in the earth's crust at depths up to 5000 to 10,000 m could possibly provide a very substantial part of the electric energy needed by mankind in the year 2000. Potential approaches for such a utilization are investigated. Basic estimates regarding the use of water as cooling medium, which will be heated by the hot walls of a cavity in the earth's crust, are considered. Aspects of energy flux from the environment are examined. Attention is given to the model of a spherical cavity, a model concerning the cooling of a cube obtained in connection with rock splitting operations, and channels having the form of a cylinder. G.R.

A77-36349 # 1-MW solar boiler tested. Y. Howell. *Sunworld,* Feb. 1977, p. 7-9.

Design and testing of equipment for a 1000 kW solar furnace facility to be operated in the French Pyrenees are described. The pilot plant will promote studies of high-temperature properties of metals and ceramics: the furnace is the only existing facility large enough to test components for solar 'power tower' systems. The solar energy receivers, the array of 63 heliostats in tiers with mirrors tracking the sun's motion across the sky under control by sensors in the reflected beam, the 1 MW boiler (8 ft tall, 10 tons), parabolic concentrator, focal sheet, and furnace buildings are described. Initial test results verified design and operational procedures. Future scale-up plans are mentioned. R.D.V.

A77-36350 # Freeze protection for solar collectors. D. R. Koenigshofer (Integrated Energy Systems, Chapel Hill, N.C.). *Sunworld,* Feb. 1977, p. 10, 11. Research sponsored by the Sunspot Solar Products.

Methods of freeze protection for solar collectors, to prevent freezing of water in solar collectors and resulting damage to the collector, were tested; energy needed to prevent freezing is calculated. The methods tested include: recirculation of water from the heat-storage tank (freeze-cycle scheme); draining water out of the collector; heating the collector plate with electric resistance heat tapes activated thermostatically; using antifreeze fluid in the collector (with a heat exchanger required in the heat-storage tank); draining water out of the collector into an auxiliary storage tank; in all cases the response are activated when the temperature drops below 36 F. The freeze-cycle method is judged safest and most cost-effective. Comparative data (costs, energy) and remarks are tabulated for the five schemes. R.D.V.

A77-36377 Progress in switching technology for METS systems. E. M. Honig, C. E. Swannack, D. H. Whitaker (California, University, Los Alamos, N. Mex.), and R. W. Warren (California, University, Los Alamos, N. Mex.; Westinghouse Research Laboratories, Pittsburgh, Pa.). *IEEE Transactions on Plasma Science,* vol. PS-5, June 1977, p. 61-65. 5 refs.

Three distinct sets of switching requirements have emerged from design optimization studies of large superconducting magnetic energy storage systems, such as the METS system to power the adiabatic plasma compression field in the proposed theta pinch SFTR. Extremely low joule loss cryogenic disconnects are required between storage coils in the liquid helium environment to allow charging the coils in series over a prolonged time, then to isolate the coils for parallel fast discharging into the load. Another switch must break the current in the series charging loop and absorb the energy from the stray inductance. This action will allow the subsequent opening of the cryogenic disconnects under near zero current condition. The current now has been transferred to the many paralled circuits, each containing a high current, high voltage interrupter. The opening and arc commutation of the interrupter starts the energy transfer into the load. (Author)

A77-36381 * Design of closed-cycle MHD generator with nonequilibrium ionization and system. R. E. Voshall, R. J. Wright, and R. W. Liebermann (Westinghouse Research Laboratories, Pittsburgh, Pa.). *IEEE Transactions on Plasma Science,* vol. PS-5, June 1977, p. 110-112. 16 refs. Contract No. NAS3-19407.

A method is developed to include the nonequilibrium ionization process in the MHD generator duct design equations, and these equations are coupled to the thermodynamic conditions of the closed cycle system. This is used to relate MHD generator size, configuration and gas conditions to the overall thermodynamic efficiency of the system. The system studied consists of an MHD loop (Ar + Cs or He + Cs) topping a steam bottoming plant. B.J.

A77-36409 # The OTEC answer to OPEC - Solar sea power. C. Zener (Carnegie-Melon University, Pittsburgh, Pa.). *Mechanical Engineering,* vol. 99, June 1977, p. 26-29. 10 refs.

It has been estimated that the top isothermal layer of the tropical ocean has an 'effective head' of 960 ft. Current research projects involving Ocean Thermal Energy Conversion systems making use of this work potential are briefly described. A new type of OTEC system in which all warm water input serves as a working medium and is discarded at the same temperature as the discard of the cold water input is outlined. The seawater is foamed using a biodegradable surfactant; the tight mechanical coupling between the water vapor in a single foam cell and the liquid in its surrounding walls forms the basis of the system. The vapor and its share of the enclosing liquid move isentropically from the saturation vapor pressure for 25 C to the saturation vapor pressure for 5 C water, liberating a work potential of 2.87 J/g. C.K.D.

A77-36410 # Electrochemical energy conversion. I - Electric vehicle propulsion. F. Hirschfeld. *Mechanical Engineering,* vol. 99, June 1977, p. 30-35.

Progress in the development of electrochemical cells for eventual application in automotive propulsion systems is surveyed. Test data presented for two lithium/iron sulfide cells show high specific energies; however, cost and durability problems remain to be solved. Progress has been made in reducing the cost of nickel-zinc systems. Projected cost of a 300 A-hx cell approaches $50.00/kWh. Recent work has demonstrated stable high performance of prismatic, uncharged Li-Al/FeS cells for periods exceeding 1000 hr and 50 cycles. C.K.D.

A77-36411 Solar energy in the building (L'énergie solaire dans le bâtiment). C. Chauliaguet, P. Baratsabal, and J.-P. Battellier. Paris, Eyrolles Editeur, 1977. 202 p. In French. $28.40.

A review of experience to date in the practical application of solar energy in a number of countries is provided. Methods of *determining the amount of solar energy available in a given* geographical area are described, and the thermodynamic principles governing the use of solar energy are treated. The basic components of solar energy systems are discussed, with special attention to the different types of collectors. A general discussion of solar systems for a variety of purposes, including distillation, climitization, heating, and hot water production is followed by an examination of results obtained in the application of such systems. The cost of individual components and their installation are outlined. Legal problems posed by the use of solar energy are considered, as are directions of future research and development efforts. C.K.D.

A77-36422 Present status of fluidised-bed combustion. J. Gibson (Coal Research Establishment, Cheltenham, Glos., England).

Applied Energy, vol. 3, Apr. 1977, p. 87-99. 13 refs.

The worldwide interest in various fluidized-bed combustion systems is surveyed. The stage of development reached towards fully commercial boiler systems using fluidized-beds operating at atmospheric pressure for a range of applications from small shell boilers to power generating units is illustrated, using as specific examples projects based on NCB technology by UK boiler makers. Adaptation of the techniques to low-grade fuels, tailings, waste incineration and crop drying has been demonstrated. Whilst commercial atmospheric boilers are likely to be operating in the next few years, the development of fluidized combustion at pressure waits on the demonstration by large test rigs that they can be successfully coupled with a gas turbine. Proposed rigs in the USA, Germany and the UK are described. (Author)

A77-36424 Energy management. P. W. O'Callaghan and S. D. Probert (Cranfield Institute of Technology, Cranfield, Beds., England). *Applied Energy,* vol. 3, Apr. 1977, p. 127-138. 5 refs.

Metering, critically examining and if necessary modifying the energy flow through a system is desirable in order to achieve a high efficiency. Systematic procedures for energy management and audit of processes and products are suggested: they involve energy flow charts and assessment questionnaires and thereby facilitate the location, and reduction or elimination, of energy profligate subsystems. Design rules for the improvement of energy flow systems are listed. (Author)

A77-36426 Solar collection systems - The rationale. R. Padillo (Northrup, Inc., Hutchins, Tex.). *ASHRAE Journal,* vol. 19, June 1977, p. 42-46.

The design rationale for the basic units of liquid media solar collection systems is examined, with attention given to both flat plate and tracking concentrator collectors. Two major problems which must be addressed during the installation design stage of all systems - freeze up (caused by low outdoor air temperatures when the collectors are not gathering energy) and stagnation - are discussed. Guidelines are offered for designing solar collection systems to minimize these problems. Design solutions found in available systems are described. C.K.D.

A77-36427 Thermal storage - A sleeping giant. R. T. Tamblyn (Engineering Interface, Ltd., Willowdale, Ontario, Canada). *ASHRAE Journal,* vol. 19, June 1977, p. 53-57.

The application of thermal storage in commercial buildings with significant interior heating gain, some of which may be solar originated, is examined. It is shown that the installation of an incremental water chiller to supplement existing chillers can minimize the cost of energy by saving fuel and reducing electric cooling demand and electric utility investment. The cost of thermal storage systems is discussed, and factors affecting the location of such systems are briefly considered. C.K.D.

A77-36433 Regional energy availability from conversion of solid waste. D. Garofalo and K. R. Martin (Earth Satellite Corp., Washington, D.C.). *Photogrammetric Engineering and Remote Sensing,* vol. 43, June 1977, p. 727-738. 12 refs.

Multi-scale remote sensing records, when used in conjunction with suitable waste production and energy usage multipliers derived from ground-based investigations, can contribute useful quantitative and spatial information relating to (1) the generation of solid organic wastes in urban and rural environments; (2) the energy requirements in terms of residual fuel oil of urban/industrial areas; and (3) the collection and transportation of organic wastes to energy conversion and distribution facilities for meeting regional urban/industrial energy needs. (Author)

A77-36434 Energy and aerospace /Sixty-fifth Wilbur and Orville Wright Memorial Lecture/. R. C. Seamans, Jr. (ERDA, Washington, D.C.). *Aeronautical Journal,* vol. 81, Apr. 1977, p. 147-169. 92 refs.

Some ways that aerospace science can contribute to conserving or obtaining energy are discussed. Developments leading to increased fuel efficiency and the possibility of using alternative fuels for aviation are considered, as is the use of fuel-efficient lighter-than-air vehicles for transporting heavy cargo. It is suggested that remote aircraft and spacecraft sensing can be used to prospect for fossil fuels, geothermal resources, and uranium, and that data obtained from earth resources satellites can be used for planning and monitoring energy activities. The prospect of capturing solar energy in space and transmitting it for use on earth is also examined. M.L.

A77-36449 Solar thermal systems (Solarthermische Systeme). W. Kleinkauf. *Sonnenenergie,* vol. 2, Jan.-Feb. 1977, p. 11, 12, 14. In German.

The solar thermal systems considered include systems employing low-temperature collectors of solar energy and systems with high-temperature collectors. Systems with low-temperature collectors, which are generally designed as flat plate collectors, can be employed in Germany for the supply of one- or two-family houses with heat and warm water. The installation of high-temperature collector systems in Germany for the generation of mechanical or electrical energy does not appear economical. The possibility is considered to establish solar farm and solar tower installations in Southern Europe or Northern Africa, taking into account questions related to the transportation of energy to Germany. G.R.

A77-36450 80 per cent of the heat requirements satisfied by the sun (80 Prozent des Wärmebedarfs durch Sonne). H. Grallert. *Sonnenenergie,* vol. 2, Jan.-Feb. 1977, p. 17, 18, 20. In German.

A description is presented of a solar house in Otterfing in Germany. The one-family house considered has an area of 183 sq m living space. An active solar-energy collector area of 80 sq m is to provide 80% of the heat needed. Optimal thermal insulation methods are used to reduce the heat requirements of the house to 21,000 kWh. Solar energy is used throughout the entire year to obtain warm water for space heating and other applications. Only energy requirements of about 4000 kWh must still be satisfied with the aid of fuel oil. Attention is given to questions of collector installation, the collector cycle, problems of heat transfer, the heat storage system, the warm water cycle, aspects of space heating, and details of operational control. G.R.

A77-36526 Space shuttle missions of the 80's; Proceedings of the Twenty-first Annual Meeting, Denver, Colo., August 26-28, 1975. Parts 1 & 2. Meeting sponsored by AAS, AIAA, IEEE, ORSA, and IMS. Edited by W. J. Bursnall, G. W. Morgenthaler, and G. E. Simonson (Martin Marietta Aerospace, Bethesda, Md.). San Diego, Calif., American Astronautical Society (Advances in Astronautical Sciences. Volume 32, pt. 1 and pt. 2), 1977. pt. 1, 593 p.; pt. 2, 755 p. Price of two parts, $85. (For individual items see A77-36527 to A77-36556)

The Large Space Telescope Program is discussed with emphasis on mirror development, telescope performance, instrument and detector development, data management, mission analysis maintainability, and pointing and control systems. Attention is also given to the AMPS (Atmospheres, Magnetospheres, and Plasmas-in-Space) program and to the Space Tug and Interim Upper Stage programs. Spacelab and automated payloads programs are also discussed along with energy in the Shuttle era. B.J.

A77-36555 Energy research overview - Alternatives for energy development. T. J. Vogenthaler (Colorado Energy Research Institute, Golden, Colo.). In: Space shuttle missions of the 80's; Proceedings of the Twenty-first Annual Meeting, Denver, Colo., August 26-28, 1975. Part 2. (A77-36526 16-12) San Diego, Calif., American Astronautical Society, 1977, p. 1223-1237. (AAS 75-280)

Energy research projects are surveyed with attention to procedures for improving the yield from both traditional and proposed

energy sources. With respect to oil fields, tertiary recovery is possible, involving the introduction of steam, in situ combustion, carbon dioxide, miscible flooding agents, or surfactants. Improved methane drainage and continuous haulage of coal would increase coal mine productivity. The problems involved in in situ retorting of oil shale are discussed. The shale must first be broken up and then heated to about 900 F to convert the solid organic material to oil. The salient problems in using other sources of energy are also considered. M.L.

A77-36556 100 MWe solar power plant design configuration and performance. F. A. Blake (Martin Marietta Aerospace, Denver, Colo.). In: Space shuttle missions of the 80's; Proceedings of the Twenty-first Annual Meeting, Denver, Colo., August 26-28, 1975. Part 2. (A77-36526 16-12) San Diego, Calif., American Astronautical Society, 1977, p. 1293-1300. 6 refs. NSF Grant No. AER-74-07570. (AAS 75-288)

Design parameters for a proposed 100 MWe solar power plant include: layout area, 405 acres (8 modules of 45 acres for solar energy collection and 1 module of 45 acres for power plant site); 1840 heliostats in each of the 8 collector modules, with each heliostat being 400 sq ft in area; the turbine-generator would be one unit rated at 100,000 kWe operating on 1250 psig, 950 F steam; air-cooled condenser; tower-mounted heat exchanger system would involve 8 units mounted along south border of modules, with a tower height of 400 ft or 450 ft above lowest elevation mirror; and the boiler/superheater would have a cavity configuration with 20 sq ft apertures. Design features and the projected performance are examined in detail. M.L.

A77-36584 Photovoltaic properties and junction formation in CuInSe2. B. Tell and P. M. Bridenbaugh (Bell Telephone Laboratories, Inc., Holmdel, N.J.). *Journal of Applied Physics,* vol. 48, June 1977, p. 2477-2480. 10 refs.

Studies of diffusion and photovoltaic effects in CuInSe2 p-n junctions are reported. Junctions were formed by annealing Zn-, Cd-, and Cu-plated p-type samples at temperatures from 200 to 450 C. The most efficient photodetectors are formed by 5-10-min anneals at 200 C with a calculated interdiffusion coefficient of about 5 times 10 to the -10th sq cm/sec. (Author)

A77-36605 Energy recovery from municipal and industrial waste. B. G. Kreiter (Stichting Verwijdering Afvalstoffen, Amersfoort, Netherlands). *Conservation and Recycling,* vol. 1, no. 1, 1976, p. 71-81. 37 refs.

A detailed analysis is given of the economics of heat recovery and utilization in the incineration of waste materials. Energy may be recovered as heat with or without electricity generation but, since electricity may be generated at little marginal cost, only the alternatives involving its production are considered. Detailed calculations are made for the economic implications of treating 140,000 tons of waste annually, and a net saving of 23 million cu m of natural gas is indicated. It is not yet possible to compare incineration with pyrolysis since much information regarding the latter is still unavailable, but published figures indicate that an energy saving of 430 kWh per ton of waste is attainable by combustion of fuels produced by pyrolysis in a utility power station. Incineration for steam production, followed by electricity generation, can save about 730 kWh per ton of waste. (Author)

A77-36608 Disposal of toxic wastes. I - Electroplating and electrochemical machining wastes. II - Poisonous and radioactive wastes. P. J. Boden (Nottingham University, Nottingham, England). *Conservation and Recycling,* vol. 1, no. 1, 1976, p. 111-128. 24 refs.

The paper comprises two parts, the first dealing with electroplating and electrochemical machining effluents and the other with poisonous and radioactive wastes. Some easily recognized pollutants of rivers and waterways are capable of treatment for the profitable recovery of values. Radioactive and certain poisonous substances, on the other hand, are genuine waste products which have to be stored and from which the general public must be protected. Simple dilution of plating effluents has, until recently, been considered an adequate safety measure, but worldwide experience shows that even diluted effluents can cause serious pollution and contamination. Several methods of control are described. Certain poisonous and radioactive wastes arise as a result of industrial processes and many cannot economically be used again or easily rendered harmless. Their disposal must therefore be permanent and under adequate control. (Author)

A77-36612 Energy conservation and a healthy economy. T. F. Widmer (Thermo Electron Corp., Waltham, Mass.) and E. P. Gyftopoulos (MIT, Cambridge, Mass.). *Technology Review,* vol. 79, June 1977, p. 31-40. 13 refs.

Technical and cost bases for energy conservation centered on drastic improvements in real system efficiencies, and a comprehensive Accelerated Conservation Policy (ACP) are outlined. Co-generation of forms of energy for dual or multiple purposes simultaneously is recommended wherever feasible and efficient, and searches for such system improvements are encouraged. Percentage efficiency improvements in energy use in a variety of energy-consuming processes and services are cited. Energy utilization efficiency improvements are illustrated by a more detailed discussion of improvements in the use of air conditioning and waste heat recovery. Some existing economic and policy impediments to energy conservation as recommended are outlined. R.D.V.

A77-36615 Advanced motor developments for electric vehicles. E. P. Cornell, R. H. Guess, and F. G. Turnbull (GE Research and Development Center, Schenectady, N.Y.). *IEEE Transactions on Vehicular Technology,* vol. VT-26, May 1977, p. 128-134. 7 refs.

Advances in motors and drives can make a significant improvement in the performance and cost effectiveness of electric vehicles (EV's) - increasing the vehicle range by as much as 20 per cent, while reducing costs as much as 15 per cent below present levels. Preliminary studies suggest that improvements in conventional dc motors and drives can only achieve modest improvements (about 3 per cent in range and 10 per cent in cost). Two advanced motor concepts - electronically-commutated motors and permanent-magnet motors - appear more promising. (Author)

A77-36627 # Cool it, sun. R. A. Slayman. *Bee Hive,* vol. 52, Winter-Spring, 1977, p. 8-11.

A self-contained two-loop heat pump system using a conventional refrigerant as working fluid in both power and cooling loops (the United Technologies Research Center system), for heating and cooling of living space, is described. The cooling loop resembles the mechanism of a conventional air conditioner, but with electric motor in the compressor drive replaced by a miniature turbine. Hot water from the collector-storage unit vaporizes the refrigerant in the cooling mode; expansion through the turbine does work on the cooling loop compressor. Hot water is pumped directly to the evaporator in the heating mode, for transfer to the heat circulation system. Plans for domestic cooling/heating using solar energy, including a system using a fuel cell, are discussed. R.D.V.

A77-36634 Technologies lead to conservation. A. L. Selman and J. M. Swotinsky (U.S. Army, Manufacturing Technology Directorate, Picatinny Arsenal, Dover, N.J.). *ManTech Journal,* vol. 2, Winter 1977, p. 41-48.

Measures aimed at energy conservation in munitions production under the DOD, a heavy energy-consuming sector in one of the nation's largest energy users, are described and evaluated. Opportunities for energy conservations are seen in: improved insulation, waste heat recovery, reduced forging temperatures, energy reclamation from solid wastes, removal of high-explosive fillers with a cavitating water jet, and applications of advanced technologies (biomass conversion, geothermal steam and water utilization, solar energy,

nuclear power). Audits of production steps to identify foci of energy wastage, applications of infrared thermography in energy inventorying, and use of heat pipe to recover waste heat are discussed. R.D.V.

A77-36672 Composite fiber flywheel for energy storage. J. A. Rinde, T. T. Chiao, and R. G. Stone (California, University, Livermore, Calif.). In: Bicentennial of materials; Proceedings of the Eighth National Technical Conference, Seattle, Wash., October 12-14, 1976. (A77-36669 16-23) Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1976, p. 25-43. 10 refs. Contract No. W-7405-eng-48.

Aspects of flywheel mechanics are discussed along with flywheel applications, taking into account flywheel designs using isotropic or composite materials, a flywheel-battery commuter car, and stationary flywheels. The characterization of fiber composite properties is considered, giving attention to fiber properties, matrix properties, static composite properties, stress-time properties of composites, and the dynamic fatigue of composites. A description is given of a number of programs which are concerned with a study of the potential of composite flywheels. G.R.

A77-36673 Thin films in energy systems. R. S. Ross (Kent State University, Kent, Ohio). In: Bicentennial of materials; Proceedings of the Eighth National Technical Conference, Seattle, Wash., October 12-14, 1976. (A77-36669 16-23) Azusa, Calif., Society for the Advancement of Material and Process Engineering, 1976, p. 44-51.

The development and use of thin plastic films as structural materials is discussed. The employment of air supported structure greenhouses utilizing very low cost highly transparent plastic film with a good life potential makes it possible to raise tomatoes in Ohio at costs which are much lower than those incurred in connection with the use of glass greenhouses. Attention is also given to the use of air supported structures for the protection of construction sites, low cost solar collectors using plastic films, an air supported structure with plastic films as a cover over a deep solar pond, chambers constructed with plastic film for pollution control, and applications related to low cost transportation systems involving the use of helium. G.R.

A77-36708 # Investigation of the flow and the temperature distribution in the vapor duct of a high-temperature heat pipe (Issledovanie techeniia i raspredeleniia temperatur v parovom kanale vysokotemperaturnoi teplovoi truby). E. N. Shevchuk and N. V. Chistop'ianova (Akademiia Nauk Ukrainskoi SSR, Institut Tekhnicheskoi Teplofiziki, Kiev, Ukrainian SSR). *Teplofizika i Teplotekhnika,* no. 32, 1977, p. 75-81. 11 refs. In Russian.

The problem of calculating the axisymmetric laminar flow of viscous sodium vapors of variable properties in a high-temperature heat tube is formulated and solved. It is shown that the compressibility of the flow and the chemical transformations occurring in it must be taken into consideration. V.P.

A77-36724 Active solar-heating systems for houses. W. A. Shurcliff (Harvard University, Cambridge, Mass.). *Sunworld,* Nov. 1976, p. 12-14.

Difficulties in applying the traditional concept of efficiency to solar-heating systems designed for houses are discussed. Adaptations which improve the efficiency are described, and the drawbacks of these adaptations are considered. It is concluded that it is more important to design a system that will collect energy reliably and cheaply, rather than to seek high efficiency per se. M.L.

A77-36725 The year 2000 - Energy enough. C. Starr (Electric Power Research Institute, Palo Alto, Calif.). *EPRI Journal,* vol. 1, June 1976, p. 6-13.

The pattern of economic growth in the United States during this century is compared with changes in the level of energy consumption. The social consequences of saving energy by reducing the rate of economic growth or by adopting a non-growth energy policy are considered. An energy conservation policy which emphasizes increased efficiency gained by technological improvements rather than restricted end-use options is strongly advocated. Trade-offs between energy conservation and the implementation of procedures and devices to protect the environment are briefly discussed. Projected electricity outputs for different fuel sources in the year 2000 are given. C.K.D.

A77-36763 Coal gasification update. E. J. Ferretti and S. Kasper (Dravo Corp., Pittsburgh, Pa.). *Energy Communications,* vol. 3, no. 3, 1977, p. 203-211.

Recent advances in coal gasification projects are summarized. Commercial ventures using the Lurgi, Winkler, and Koppers processes are briefly described, and progress in research and development projects involving new gasification processes is outlined. Possible reasons for the sharp upswing in projected capital cost of high BTU commercial scale plants are examined. C.K.D.

A77-36764 Solar shade control - New law for a new technology. S. F. Kraemer and J. G. Felt. *Energy Communications,* vol. 3, no. 3, 1977, p. 213-230. 28 refs.

The potential utility of solar collectors in providing a pollution-free energy source for residential and commercial buildings renders the formulation of legislation to protect such devices from shading during peak sunlight hours highly desirable. It is argued that simplest and most direct approach to the protection of a solar collector from a shadow is to be found in the inherent right, under the police power of a sovereign, to declare such a shadow a public nuisance. A model solar share control law affecting only trees and shrubs is provided. C.K.D.

A77-36765 Factors influencing the economics of large-scale in situ coal gasification operations. M. K. Buder, R. A. Fisher, A. I. McCone, O. N. Terichow, and M. J. Wong (Bechtel, Inc., San Francisco, Calif.). *Energy Communications,* vol. 3, no. 3, 1977, p. 231-252. 5 refs.

Results of a comparative study of the economics of underground and surface coal gasification for the production of electrical power or natural gas are analyzed. Order-of-magnitude and operating costs were derived for four power plants and for four plants producing substitute natural gas from a variety of coals, with both western and eastern types represented. Results show savings of up to 25% with underground gasification. Operating costs for well drilling and piping are the governing factors in the economics of underground gasification, accounting for about 17% of the total plant operating cost in the West and 42% in the East, with the higher figure reflecting differences in coal seam geometry and in drilling techniques. Costs may be reduced by maximizing coal seam thickness and well spacing and by minimizing coal seam depth. Most important areas for development are in drilling techniques and in techniques for the optimization of coal recovery. C.K.D.

A77-36766 Direct production of methane and benzene from coal. A. L. Pelofsky, M. I. Greene, and C. J. LaDelfa (Cities Service R & D Co., Cranbury, N.J.). *Energy Communications,* vol. 3, no. 3, 1977, p. 253-272. 13 refs.

Experimental data obtained when processing a North Dakota lignite in a bench-scale experimental system utilizing the Cities Service flash hydrogenation process for the production of hydrocarbons from coal are reported. Pulverized coal particles are heated rapidly with hot hydrogen. The hydrogenation reaction has a 50-900 millisecond residence time and occurs at commercially feasible reactor pressures (500-3000 PST). Volatile products are rapidly quenched to prevent decomposition. Carbon conversions of 80% have been obtained, with liquid yields of as high as 16%. The liquid product is essentially 94% pure benzene; the gas obtained is primarily methane and ethane. C.K.D.

A77-36767 **Toward establishing a national energy policy.** J. L. Gaddy (Missouri-Rolla, University, Rolla, Mo.). *Energy Communications,* vol. 3, no. 3, 1977, p. 273-291. 18 refs.

Coal must become the predominant energy source for this nation for the next 50-100 years and petroleum must be conserved for petrochemicals. Coal gasification and liquefaction are wasteful processes that will lead to unnecessarily rapid depletion of coal reserves. Generation of electricity with coal is a more economical means of using coal for energy and this technology is already available. This paper discusses the advantages of a coal-electric energy economy and how such an economy can be implemented. (Author)

A77-36768 **Residential energy use alternatives to the year 2000.** E. Hirst (Oak Ridge National Laboratory, Oak Ridge, Tenn.). *Energy Communications,* vol. 3, no. 3, 1977, p. 293-312. 9 refs.

A comprehensive engineering-economic computer model used to simulate energy use in the residential sector from 1970 to 2000 is described. The purpose of the model is to provide an analytical tool with which to evaluate a variety of conservation policies, technologies, and strategies for their impacts on residential energy use and fuel expenditures over time. The baseline forecast developed here shows total fuel use growing from 17.6 GGJ (ten to the 18th joules) in 1975 to 26.4 GGJ in 2000, with an average annual growth rate of 1.7%. The percentage of household fuel provided by electricity grows from 44% in 1975 to 56% in 2000. The percentages provided by all other fuels decline over time. Alternative high and low forecasts show a range in annual fuel use growth from 1975 to 2000 of 2.1% to 0.3%. (Author)

A77-36788 # **Energy utilization factor in civil transport aircraft (Il fattore di utilizzazione dell'energia nei velivoli civili da trasporto).** G. Guerra (Torino, Politecnico, Turin, Italy). *Ingegneria,* Mar.-Apr. 1977, p. 65-72. 8 refs. In Italian.

Energy utilization factor (EUF) is related to several performance parameters of civil transport aviation: aerodynamic efficiency, propulsion efficiency, and specific fuel consumption. Influence on direct operating costs by fuel consumption (now around 40% of DOC) is noted. Improvements in three efficiency factors mentioned are judged the best approach to cost effectiveness. EUF estimates are plotted for various aircraft types and various types of transportation vehicles. R.D.V.

A77-36796 **Solar energy - A part of the answer.** *Power,* vol. 121, Mar. 1977, p. 38-43.

Direct thermal applications of solar energy (for heating and cooling buildings and heating liquids) are discussed. The basic design features of flat-plate and concentrating collectors are described. The key components of a solar system using a flat-plate collector are examined, and general guidelines for the design, installation and maintenance of such a system to avoid problems of corrosion, deterioration, freezing, condensation and leaking are given. Cost estimates for two flat-plate systems are presented together with a brief discussion of design requirements for electric power generation using solar energy. C.K.D.

A77-36797 **Economic benefits of energy conservation.** M. R. Seidel (Federal Power Commission, Office of Energy Systems, Washington, D.C.). *Energy Systems and Policy,* vol. 2, no. 1, 1977, p. 1-30. 9 refs.

The economic impact of energy conservation is considered. An analysis is presented which suggests that conservation-oriented responses are more cost-effective than supply-expanding responses. The paper examines this net cost effectiveness and quantifies it in several dimensions of the nation's economy. Benefits of energy conservation to various end-use sectors of the economy are discussed. Capital requirements are described. It is suggested that energy conservation would result in higher employment since conservation is labor intensive. (Author)

A77-36798 # **The electric vehicle.** R. J. Fosdick. *Automotive Industries,* vol. 156, Mar. 1, 1977, p. 27-34.

The prospects for increased use of electric vehicles are examined. It is suggested that electric vehicles will serve as a supplement to gasoline-powered automobiles and will find use as commuter cars, a second car for suburban shopping trips, or as city cars. Improvements in battery technology which would lead to a reduction in the weight or cost, or an increase in the range or number of rechargeable cycles, are considered of key importance. Nickel-zinc batteries weigh less than currently-used lead-acid batteries and might soon progress beyond the development stage. Although several ambient-temperature batteries are being investigated, including improved lead-acid, nickel-iron, and zinc-air, the high-temperature lithium-sulfur battery is thought to provide the greatest likelihood of a breakthrough to economically-attractive electric vehicles. High-temperature sodium-sulfur batteries are also being studied. These batteries would operate at temperatures over 300 C and require the solution of sealing and corrosion problems. Solid-state control developments are also discussed. M.L.

A77-36799 # **Solar energy - Where are the opportunities.** P. E. Glaser (Arthur D. Little, Inc., Cambridge, Mass.). *Aware,* Feb. 1977, p. 2-5.

The prospects of various methods for utilizing solar energy are considered with attention to the commercial potential of a solar climate control system. A full solar climate control system would involve a solar collector, thermal storage medium, conventional energy source interface, heat-actuated air conditioner, heat pump, and auxiliary equipment required to combine the components into an operating system. Costs for solar water heaters are said to be about $1500 per installation and are expected to be reduced to about $1000, while solar heating systems for a three-bedroom residence are said to range from $3000 to $5000 depending on location. Because a solar climate control system consists of many components, it is considered unlikely that one company would dominate the industry, although manufacturers are warned that sales of solar climate control equipment will be slow at first. New business opportunities are examined. M.L.

A77-36801 **Energy prospects in the Netherlands.** D. G. H. Latzko (Delft, Technische Hogeschool, Delft, Netherlands). *Delft Progress Report, Series A-F (General Issue),* vol. 1, Dec. 1976, p. 1-24. 19 refs.

Following a survey of the world energy situation, an analysis is presented of energy sources available to the Netherlands. Methods of reducing energy losses are considered. An economic model for predicting energy consumption is described. Proposals for stabilizing total energy consumption are weighed. Technological improvements that would facilitate exploitation of proved energy sources are examined. The energy that can be obtained from different sources and techniques is estimated. Undesirable side-effects of different modes of energy production are noted. M.L.

A77-36806 **Symposium on Gasification and Liquefaction of Coal, Düsseldorf, West Germany, January 12-16, 1976, Reports.** Symposium sponsored by the U.N. Economic Commission for Europe. Geneva, United Nations, Economic Commission for Europe, 1976. 165 p. (For individual items see A77-36807 to A77-36814)

The present state and development potential of coal gasification are discussed with attention directed to the fundamentals of coal gasification and liquefaction, gasification coupled with the generation of electricity, and underground gasification. Several gasification technologies, including the Winkler, Lurgi, Hygas, and Synthane processes, are discussed in two reports, one dedicated to conventional processes, the other to advanced processes. Research and intended uses in different regions of the world are also considered. M.L.

A77-36807 # **North American views of energy choices for the future particularly fluid fuels synthesized from coal.** P. J. Read

(Department of Energy, Mines and Resources, Ottawa, Canada). In: Symposium on Gasification and Liquefaction of Coal, Düsseldorf, West Germany, January 12-16, 1976, Reports. (A77-36806 16-44) Geneva, United Nations, Economic Commission for Europe, 1976. 23 p. 8 refs.

Energy demands in the United States and Canada are examined and several fuel supply scenarios are described. Interest in coal gasification technologies is thought to depend to some extent on the quantities of additional oil and gas reserves located, and on the extent to which more gas and oil can be obtained by improved recovery techniques. Some contrasts between the U.S. and Canada with regard to coal gasification are considered. Canada, which can produce more natural gas than is used domestically, has less need than the U.S. to develop coal gasification facilities. Also, gasification methods for treating strongly caking coals are more applicable to the coals of eastern and central U.S. than to coals in western Canada. On the other hand, Canadian gas companies would not be hindered by present laws to expand into the field of coal utilization, while such an expansion by a private company in the U.S. might conflict with antimonopoly legislation. M.L.

A77-36808 # **Trends in western Europe.** B. Braubach. In: Symposium on Gasification and Liquefaction of Coal, Düsseldorf, West Germany, January 12-16, 1976, Reports. (A77-36806 16-44) Geneva, United Nations, Economic Commission for Europe, 1976. 7 p.

It is suggested that in western Europe lignite gasification would be cheaper than coal gasification. Hard coal is much more expensive than lignite to mine. Lignite gasification using nuclear process heat is considered to have a potential for profitability under current economic conditions, but coal liquefaction is not thought to be a viable process in the western European context. Greater concern with gasification research is anticipated in the future. M.L.

A77-36809 # **Fundamentals of coal gasification.** W. Peters (Bergbau-Forschung GmbH, Forschungsinstitut des Steinkohlen-Bergbauvereins, Essen, West Germany). In: Symposium on Gasification and Liquefaction of Coal, Düsseldorf, West Germany, January 12-16, 1976, Reports. (A77-36806 16-44) Geneva, United Nations, Economic Commission for Europe, 1976. 11 p.

After a brief review of the origin and the typical composition of coal, the paper deals first with the main reactions in gasification, combustion and gas processing. Thermodynamic conclusions are drawn concerning the product gas composition of steam gasification and its dependence on temperature and pressure. As the rate of carbon conversion is of utmost importance for technical processes, the different steps of the overall reaction which may become rate determining are illustrated next. Then the temperature and pressure dependence of the kinetics of steam and hydrogasification are given. Lastly, possible industrial processes for carrying out steam gasification are reviewed, with particular attention being given to the various possibilities that have been suggested for generating the reaction heat using either autothermal or allothermal processes. Moreover examples are given of well-known autothermal processes which are currently performed and use fixed-bed, fluidized-bed or entrained-bed techniques. Special attention is given to the advantages, the disadvantages and the future potential of the processes mentioned. (Author)

A77-36810 # **Conventional gasification technologies.** D. C. Elgin (Institution of Gas Engineers, London, England). In: Symposium on Gasification and Liquefaction of Coal, Düsseldorf, West Germany, January 12-16, 1976, Reports. (A77-36806 16-44) Geneva, United Nations, Economic Commission for Europe, 1976. 18 p. 9 refs.

The Winkler, Lurgi, and Koppers-Totzek gasification processes are compared. The Winkler process uses a fluidized fuel bed; the Lurgi, a 'fixed' (slowly downwards-moving) fuel bed; the Koppers-Totzek, entrainment of the coal or other feedstock. The dependency of these processes on coal type and sizing, temperature, atmosphere, pressure, and water vapor is examined. The economic impact of various operating conditions and modifications is analyzed. Methanation of initially produced gases to create synthetic natural gas is also considered. Besides application as fuels, coal gasification products can be used in industrial processes. A comparison of primary product gases (sulfur free) resulting from steam/oxygen gasification by the three techniques is presented. M.L.

A77-36811 # **Advanced gasification technologies.** P. Speich (Rheinische Braunkohlenwerke AG, Cologne, West Germany). In: Symposium on Gasification and Liquefaction of Coal, Düsseldorf, West Germany, January 12-16, 1976, Reports. (A77-36806 16-44) Geneva, United Nations, Economic Commission for Europe, 1976. 19 p.

Hygas, CO2-acceptor, synthane, coalcon, bi-gas, hydrane, and texaco processes of coal gasification are described. In general, common characteristics include gasification under pressure of 40 to 70 bar, more than one stage in the process, and gasification in a fluidized bed. Gasification under pressure permits higher outputs in relation to time and volume, higher methane formation, and obviation of the need for additional consumption of energy for compression. On the other hand, the presence of pressure necessitates special facilities for feeding the coal into the gasification reactor and for the discharge of ashes or slag. A multistage process might include one stage for hydrogasification and another stage for converting the residual char into a hydrogenous gas. A fluidized bed facilitates mass and heat transfer. Also described are gasification processes with partial combustion of the coal, fixed bed gasification under pressure, gasification in slag baths, oil, and molten metals, and modernizations of traditional gasification procedures. The use of process heat for hydrogasification and steam gasification is also examined. M.L.

A77-36812 # **Gasification and generation of electricity.** M. Macura (Fuel Research Institute, Bechovice, Czechoslovakia). In: Symposium on Gasification and Liquefaction of Coal, Düsseldorf, West Germany, January 12-16, 1976, Reports. (A77-36806 16-44) Geneva, United Nations, Economic Commission for Europe, 1976. 16 p. 10 refs. Translation.

The STEAG process, which generates electricity from coal by gasification, is described. This system uses a pressurized fixed bed for gasification and a steam-gas cycle for producing electricity. The efficiency, gas purification, and proposed improvements of this technique are discussed. Fluidized bed procedures are also considered, with attention to the Westinghouse, U-gas, and VEW processes. The disadvantages of the fixed-bed technique are that caking coals and coals with small particle sizes can not be used, the raw gas contains numerous impurities, and energy efficiency is reduced by cooling the raw gas. The potential advantages of the fludized-bed process in comparison with the fixed-bed process with regard to these features are examined. M.L.

A77-36813 # **Underground gasification.** P. Ledent (Institut National des Industries Extractives, Liège, Belgium). In: Symposium on Gasification and Liquefaction of Coal, Düsseldorf, West Germany, January 12-16, 1976, Reports. (A77-36806 16-44) Geneva, United Nations, Economic Commission for Europe, 1976. 22 p. 27 refs. Translation.

Several underground gasification projects are described with attention to required pretreatment of the combustion area, gas output, and gas composition. Most processes already tested in situ involve low-pressure methods. The disadvantages of low-pressure techniques are that they usually require comparatively thick low-depth coal deposits (which generally are cheaper to mine), and that they threaten surface water and the surrounding air, and therefore people living close by, if the gas escapes from underground. Gasification of coal more than about 600 meters deep would proceed at high pressure and produce compressed gas. In comparison with shallow low-pressure gasification, there would be a reduced likelihood of gas leaks and increased thermal stability. Although the cost of drilling several holes to great depths is a disadvantage, it is

suggested that high-pressure gasification might become the preferred procedure for utilizing deep coal deposits. M.L.

A77-36814 # **Fundamentals of coal liquefaction.** J. Leskiewicz (Ministerstwo Gornictwa i Energetyki, Katowice, Poland). In: Symposium on Gasification and Liquefaction of Coal, Düsseldorf, West Germany, January 12-16, 1976, Reports. (A77-36806 16-44) Geneva, United Nations, Economic Commission for Europe, 1976. 17 p. 25 refs.

Several coal liquefaction processes are described which generally involve extraction by oil and catalytic hydrogenation at high temperatures (over 400 C) and pressures (commonly in the range of 50 to 250 atmospheres). The chemical structure of coal, the significance of its composition, operating conditions, the effect of rare elements, and oxygen removal are discussed. The second stage, hydrogenation in the gas phase, usually involves first, removing oxygen and nitrogen compounds; and second, cracking in order to produce low-molecular-weight compounds. Filtration and sedimentation procedures as well as catalyst, temperature, and pressure requirements are examined. M.L.

A77-36815 **Improvements in fluid machines and systems for energy conversion. Volume 4.** Milan, Ulrico Hoepli Editore S.p.A., 1976. 258 p. In English and French. $7.70. (For individual items see A77-36816 to A77-36821)

Attention is given to laser velocimeter studies of three-dimensional flow in a high-speed centrifugal compressor impeller, nonequilibrium ionization in a linear MHD generator, and the effects of grooved casings on the performance of axial flow compressors. Also considered are a numerical approach to the minimum thickness problem for centrifugal pump casings, and design principles for pump impellers with improved cavitation behavior. B.J.

A77-36817 **Non equilibrium ionization in a linear magnetohydrodynamic generator, using a high pressure supersonic argon flow.** J. P. Caressa (Aix-Marseille I, Université, Marseille, France). In: Improvements in fluid machines and systems for energy conversion. Volume 4. (A77-36815 16-34) Milan, Ulrico Hoepli Editore S.p.A., 1976, p. 37, 39-82. 11 refs. In French.

Magnetically induced ionization was obtained in a linear Faraday segmented MHD generator using shock heated argon as the working fluid. The aerodynamic and electrical parameters of the gas at the generator entrance and the electrical configuration of the generator were optimized so that the ionization could be observed more readily. The microscopic Hall parameter was found to be high at the duct entrance, and the nonequilibrium steady state obtained in the flowing gas was stable. B.J.

A77-36822 **Energy technology assessment - Considerations of geographical scale.** P. F. Palmedo (Brookhaven National Laboratory, Upton, N.Y.). *Journal of Energy and Development,* vol. 2, Spring 1977, p. 207-217. 21 refs. ERDA-sponsored research.

Energy technology assessment is defined as the systematic evaluation of the implications of alternative technological means to fulfill society's need for energy. The paper discusses the implications of a discrepancy between two geographical scales of concern in energy technology assessment. One is the scale of impact, e.g., the range of pollutant transport, which is affected by physical geography. The other, the geographical scale of decisions, is determined almost completely by political jurisdictions. It is suggested that energy technology assessment can bridge the gap between the phenomenological and the political geographical scales. M.L.

A77-36823 **North Slope oil and United States energy supply.** E. J. Cahill and D. E. Basye (Chevron International Oil Co., Inc., San Francisco, Calif.). *Journal of Energy and Development,* vol. 2, Spring 1977, p. 257-266. 5 refs.

The significance of the North Slope oil for the U.S. economy is discussed. Governmental decisions that would affect use of present or proposed pipelines are described. Refining constraints caused by differences in oil, which necessitate differences in refinery design, are examined. Other topics considered are moving Alaskan oil by tankers, exchanging oil with Japan as a short-term solution, and the question of whether Alaskan oil production should be reduced until Alaskan oil can be transported to areas in the U.S. needing it. M.L.

A77-36824 **The economics of solar home heating systems for the southwest region.** T. H. Stevens (New Mexico State University, Las Cruces, N. Mex.). *Journal of Energy and Development,* vol. 2, Spring 1977, p. 279-291. 23 refs.

The paper analyzes the likelihood that solar space heating and domestic hot-water systems for single family residences will become economically competitive with conventional natural gas, liquified petroleum, and electric systems in the southwest region of the country. A cost analysis is performed and the initial cost of a solar heating system is compared to the value of anticipated fuel savings over a projected 20-year operating period. Various governmental policy decisions which would affect the extent of use of solar heating systems are discussed. It is concluded that, regardless of whether there is cost competitiveness, solar heating systems are not likely to capture a major share of the energy market in the near future, although the extent of even limited use might significantly affect the requirement for imported oil. M.L.

A77-36825 **The Wisconsin Regional Energy project - An applied systems analysis approach to regional energy/environment modeling.** W. K. Foell, J. W. Mitchell, and J. L. Pappas (Wisconsin, University, Madison, Wis.). *Journal of Energy and Development,* vol. 2, Spring 1977, p. 292-309. 18 refs. Research supported by the Upper Great Lakes Regional Commission, University of Wisconsin, International Institute for Applied Systems Analysis, and NSF.

The Wisconsin Regional Energy model (WISE) is described. WISE is a computerized simulation model designed to represent the energy system within a framework that includes energy demand, conversion, transport, and environmental impact, while taking account of technological and economic considerations. The model consists of several submodels which combine data and information about energy flows to describe or simulate the energy system and its relationship to other characteristics of the region, e.g., demographic, economic, and environmental. WISE has been used to analyze energy-related issues facing Wisconsin and the Upper Great Lakes region, and also to examine energy/environment management strategies for several European countries. M.L.

A77-36936 # **The influence of finite electrode segmentation on electrical performances of the Faraday HD generator.** J. Dogaru (Research and Design Institute for Thermoenergetic Equipment, Bucharest, Rumania). *Revue Roumaine des Sciences Techniques, Série Electrotechnique et Energétique,* vol. 22, Apr.-June 1977, p. 163-170. 5 refs.

Both the electromagnetic field in the conversion duct and the electric performance of the Faraday MHD generator are determined taking into account the Hall effect and finite electrode segmentation. The spectrum of the conduction current density field in the conversion duct of the Faraday MHD generator with finite electrode segmentation is very nonuniform, the nonuniformity of the field increasing as the Hall parameter, and the ratio of electrode width to insulator width increases. The spectrum of the electric current density field and the internal resistance of the generator are independent of the operating point of the generator. The Hall parameter for finite segmentation of the duct electrodes indicates a reduction of the electric performance of the MHD generator, and this reduction is more obvious at higher electrode width to insulator width ratios. M.L.

A77-36939 # **Reduction of the transverse edge effect in linear machines with homogeneous secondary armature by changing the air gap configuration.** V. Fireteanu (Bucuresti, Institutul Politehnic, Bucharest, Rumania). *Revue Roumaine des Sciences Techniques, Série Electrotechnique et Energétique,* vol. 22, Apr.-June 1977, p. 209-215.

With consideration of a fixed cross section of the secondary armature, the effect on the force of a linear motor caused by transversely increasing the air gap, from the middle outwards, was studied. The transverse redistribution of the primary magnetic field and of the induced currents, as well as the increase of the electromagnetic force on the secondary armature, are related to the rectangular air-gap configuration. M.L.

A77-36982 # **An assessment of energy storage systems suitable for use by electric utilities.** *Aware,* Mar. 1977, p. 13-15.

The considered investigation shows that in the near-term hydro pumped storage, thermal storage integrated into a conventional power plant, and compressed air storage with combustion turbines appear technically and economically feasible. In the intermediate-term (1985-2000), advanced battery storage and hydrogen storage appear technically attractive and potentially economic. In the long-term (beyond 2000), superconductive magnetic energy storage systems could become technically feasible and might prove to be economic. G.R.

A77-36983 **The auto option.** B. Rosenthal. *Environment,* vol. 19, June-July 1977, p. 18-24. 26 refs.

The results of previous studies are used in an analysis of the problems posed and advantages offered by encouraging a massive switch from the use of private cars to the use of buses in urban areas. Although buses offer one extremely attractive feature - flexibility - the increase in fleet sizes and reductions in bus size and fares necessary to attract car users in significant numbers may offset possible fuel savings. An examination of car ownership and use patterns and of potential fuel savings offered by technological advances indicates that significant progress in fuel conservation in the near future may be more easily accomplished by firm state and national regulation of the type of vehicles manufactured for private use than by increasing the availability of bus service. C.K.D.

A77-36984 **Running out of steam. III.** A. W. Reitze, Jr. (George Washington University, Washington, D.C.). *Environment,* vol. 19, June-July 1977, p. 34-40. 36 refs.

The history of the development of systems offering an alternative to the internal combustion engine is examined to identify the causes of current pessimism regarding their future. Significant interest has been shown in the development of steam-driven alternatives to the Otto engine such as the Rankine-cycle engine and the Brayton turbine. Although steam-driven buses have produced encouraging results with respect to emission control, their fuel consumption was four times higher than that of diesel buses. The fuel economy problem has led to a deceleration of most steam-engine development efforts in this country. Progress in the development of electric-powered cars depends on success in reducing costs, in improving batteries and fuel cells, and on determining optimum vehicle weights. A small, light, short-range vehicle currently seems to be the most feasible combination of performance versus cost. Acceleration of research and development efforts for alternative engines hinges on government pressure on the industry. C.K.D.

A77-36988 # **Tidal power generation in India.** P. P. Vaidyaraman and S. B. Brahme (Central Water and Power Research Station, Poona, India). *Institution of Engineers (India), Journal, Electrical Engineering Division,* vol. 57, Feb. 1977, p. 200-205; Discussion, p. 205-206; Authors' Reply, p. 206. 5 refs.

Estimates are presented of power output from a tidal energy source with reference to developing tidal power plants in India. Tidal power plants are classified into single-basin and double-basin plants, and the possibility of tidal power plants on the west coast of India is examined. Some results of hydraulic model studies in reference to pilot plant development are discussed. B.J.

A77-36999 **Geothermal significance of magnetotelluric sounding in the eastern Snake River Plain-Yellowstone region.** W. D. Stanley (U.S. Geological Survey, Denver, Colo.), J. E. Boehl, F. X. Bostick, and H. W. Smith (Texas, University, Austin, Tex.). *Journal of Geophysical Research,* vol. 82, June 10, 1977, p. 2501-2514. 42 refs. Research supported by the U.S. Geological Survey and NSF.

Magnetotelluric sounding along a profile extending from the Raft River geothermal area in southern Idaho to Yellowstone National Park in Wyoming reveal a highly anomalous crustal structure involving a conductive zone at depths that range from 18 km in the central park of the eastern Snake River Plain to 7 km beneath the Raft River thermal area and as little as 5 km in Yellowstone. It is determined that the conductive zone at shallow depths is probably caused by elevated temperatures, and noted that these findings should have an impact on geothermal exploration and on the estimation of the total geothermal resources of the western United States. B.J.

A77-37000 # **Coal gasification power generation.** J. Holmgren (Westinghouse Research and Development Center, Pittsburgh, Pa.). *Aware,* June 1977, p. 11-14.

A description is presented of a fluidized bed coal gasification system for a combined-cycle gas turbine and steam turbine power generating plant and of investigations which are conducted to evaluate this system. A two-stage fluidized bed process gasifies coal using air and steam at temperatures in the range from 1600 to 2100 F and pressures from 15 to 20 atm. Limestone or dolomite sorbent can be used to remove sulfur from the gases at temperatures from 1400 to 1700 F. Attention is given to the coal gasification power generation process, the coal gasification process, and the coal gasification program. G.R.

A77-37084 **Automotive engines - A viable alternative for aircraft.** J. T. Camden (Geschwender Aeromotive, Inc., Lincoln, Neb.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Mar. 29-Apr. 1, 1977, Paper 770466.* 21 p.

The current status of automotive liquid-cooled aircraft engine conversions is described with respect to the air-cooled powerplants they replace. A brief historical background is included along with information on some of the most recent applications of automotive engines in aircraft. The gains in efficiency, improvement in performance, and reduction of noise level, vibration, and cost are plus factors to be considered when comparing automotive engine conversions to conventional air-cooled aircraft engines. (Author)

A77-37088 * **Flight test evaluation of a method to determine the level flight performance of a propeller-driven aircraft.** P. D. Bridges, E. J. Cross, Jr., and D. W. Boatwright (Mississippi State University, Mississippi State, Miss.). *Society of Automotive Engineers, Business Aircraft Meeting, Wichita, Kan., Mar. 29-Apr. 1, 1977, Paper 770470.* 29 p. NASA-supported research.

A flight test method has been developed for determining the level flight drag and propulsive efficiency of propeller-driven aircraft. The overall drag of the aircraft is expressed in terms of the measured increment of power required to overcome a corresponding known increment of drag, which is generated by a towed drogue. The simplest form of the governing equations, D = delta D SHP/delta SHP (where D is drag and SHP is the horsepower delivered to the propeller) is such that all of the parameters on the right side of the equation can be measured in flight. An evaluation of the governing equations has been performed using data generated by flight test of a Beechcraft T-34B. (Author)

A77-37248 # **What price wind power.** D. G. Shepherd (Cornell University, Ithaca, N.Y.). *Aware,* May 1977, p. 11-15.

Basic considerations in adapting wind power systems for different uses and locations are discussed. The role of such factors as average wind velocity and wind variation in the selection of a wind system design is examined. The advantages and disadvantages of different types of wind power systems, including lift or drag types and horizontal or vertical axis types, are discussed and compared. Wind concentration devices are briefly described. Applications of small wind energy systems are discussed, and proposals for large-scale wind-based power systems are considered. C.K.D.

A77-37251 # **Solar energy depot.** H. C. Zachmann (Associated Enterprises, Ellicott City, Md.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-726.* 7 p.

A completely new energy system is described based on the use of liquid hydrogen as a fuel, along with liquid or gaseous oxygen as an oxidizer. The concept is made economically feasible by a solar concentrator in conjunction with a free piston engine, using developments of a similar engine by Exxon Corp. and General Electric Co. to generate electricity in a closed thermodynamic system, which in turn is separately converted to liquid hydrogen. The cost effectiveness and competitive analysis with other fuels, as well as the capital investment, and other important considerations, was based on Australia as a location. Over 20 years of weather data along with a geographical analysis was used in the various options of power generation, fuel liquefaction, and cryogenic power transmission. (Author)

A77-37252 # **Thermal analysis of some flat-plate solar collector designs for improving performance.** D. L. Siebers and R. Viskanta (Purdue University, West Lafayette, Ind.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-727.* 11 p. 28 refs.

The effects of suppression of thermal radiation, conduction and/or free convection heat loss from the absorber of a flat-plate solar collector are analytically studied. A two-dimensional, steady state, heat transfer analysis is developed for a collector for this purpose. The analysis accounts for the temperature gradients in the fluid flow and vertical directions in the collector, meteorological conditions, the collimated and diffuse nature of solar irradiation, the physical and thermodynamic properties of the materials in the collector, the number of cover plates, any selective surfaces, and the collector location, orientation, and dimensions. The spectral nature of radiation heat transfer in the collector is modeled by two spectral bands, solar and thermal. The results illustrate that a single selective surface on the absorber or on the cover plate closest to the absorber to suppress thermal radiation heat loss is the most effective means of improving flat-plate collector performance when only suppressing one mode of heat transfer. (Author)

A77-37253 # **Energy from humid air.** T. K. Oliver, W. N. Groves, C. L. Gruber, and A. Cheung (South Dakota School of Mines and Technology, Rapid City, S. Dak.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-730.* 9 p. Contract No. E(49-18)-2253.

A vast amount of energy is contained in the latent heat of vaporization of the water vapor in humid air. This paper is a report on research in progress, the goal of which is to find a cost-effective process to convert the energy in humid air into mechanical work. This would be used to drive an electrical generator. The proposed structure for converting energy from humid air is a tower similar to those used for cooling in large power plants. A proposed mechanization can be thought of as a heat engine with the air itself serving as the working fluid. The research is being carried out primarily by computer modeling, with very preliminary results presented in this paper. These results lead to tentative conclusions as to what can be done to achieve a better mechanization. Some design tradeoffs are developed. The future direction of the ongoing investigation is indicated. (Author)

A77-37261 * # **Excess liquid in heat-pipe vapor spaces.** J. E. Eninger (TRW Defense and Space Systems Group, Redondo Beach, Calif.) and D. K. Edwards (TRW Defense and Space Systems Group, Redondo Beach; California, University, Los Angeles, Calif.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-748.* 7 p. Contract No. NAS2-8310.

A mathematical model is developed of excess liquid in heat pipes that is used to calculate the parameters governing the axial flow of liquid in fillets and puddles that form in vapor spaces. In an acceleration field, the hydrostatic pressure variation is taken into account, which results in noncircular meniscus shapes. The two specific vapor-space geometries considered are circular and the 'Dee-shape' that is formed by a slab wick in a circular tube. Also presented are theoretical and experimental results for the conditions under which liquid slugs form at the ends of the vapor spaces. These results also apply to the priming of arteries. (Author)

A77-37262 * # **Investigation of counterflow shear effects in heat pipes.** K. T. Feldman, Jr. and C. Thupvongsa (New Mexico, University, Albuquerque, N. Mex.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-749.* 10 p. 20 refs. Grant No. NsG-2064.

The entrainment-shear performance limit in heat pipes is investigated. The entrainment heat flux limit is defined as the condition where the Weber number is greater than or equal to one. In this analysis, the critical value for the entrainment Weber number is between 2pi and 3pi. Performance degradation due to vapor-liquid shearing stress is predicted. Preliminary qualitative experiments were conducted to observe the shear stress wave formation phenomena. The equations presented may be used to predict and minimize the vapor-liquid shear stress performance effects in axial groove and puddle flow artery heat pipes. (Author)

A77-37263 # **Performance gravity-assisted heat pipes operated at small tilt angles.** Y. Kamotani (Case-Western-Reserve University, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-750.* 9 p. 10 refs.

Performance of a gravity-assisted heat pipe operated at small tilt angles is investigated theoretically including the effect of vapor-shear. The vapor-shear creates a back-flow region at the surface of the puddle, and thereby degrades the pipe performance. A formula is obtained for the liquid pressure drop which accounts for the vapor shear effect. The performance of the pipe is strongly influenced by the fluid inventory and the tilt. It is found that if the fluid charge exceeds a certain amount, the pipe operation becomes unstable at a relatively small heat transport. (Author)

A77-37264 # **The heat pipe heat bridge and thermal controller.** F. G. Arcella (Westinghouse Research and Development Center, Pittsburgh, Pa.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-751.* 10 p. 6 refs. Research supported by the Westinghouse Electric Corp.

The described heat pipe heat bridge (HPHB) was developed to extend the range and versatility of the one set point, gas buffered, variable conductance heat pipe. The HPHB concept is analogous to that of a Wheatstone bridge. In the HPHB, a controlled ohmic heat source is applied to one end of a right, circular, cylindrical heat pipe that contains a small pocket of noncondensible gas in its central cavity. The other end of the heat pipe is inserted into the heat source that is to be controlled or measured. The controlled heat source acts in the same manner as a bellows or gas heater for a variable conductance heat pipe, but offers a much greater operating range in temperature control, and does so without moving parts. G.R.

A77-37265 # **A zero g variable conductance heat pipe using bubble pump injection.** C. C. Roberts, Jr. (Packer Engineering

Associates, Inc., Naperville, Ill.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-752.* 11 p. 5 refs.

Methods for varying the thermal conductance of a heat pipe include liquid flow control, vapor flow control and condenser blockage. A new way to vary heat pipe thermal conductance has been achieved by using a bubble pump to control return liquid flow. This has been proven in a 1-g environment. In an attempt to apply this concept to the 0-g environment, various heat pipe fluid models were tested on a 0-g simulator. The design appears feasible over a range of Bond numbers from 0-16. (Author)

A77-37266 * # **Two-phase working fluids for the temperature range 100-350 C.** E. W. Saaski (Sigma Research, Inc., Richland Wash.) and L. Tower (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-753.* 8 p. 9 refs. NASA-supported research.

The decomposition and corrosion of two-phase heat transfer liquids and metal envelopes have been investigated on the basis of molecular, bond strengths and chemical thermodynamics. Potentially stable heat transfer fluids for the temperature range 100 to 350 C have been identified, and reflux heat pipe tests initiated with 10 fluids and carbon steel and aluminum envelopes to experimentally establish corrosion behavior and noncondensable gas generation rates. (Author)

A77-37271 * # **The multistage heat pipe radiator - An advancement in passive cooling technology.** D. E. Wilson and J. P. Wright (Rockwell International Corp., Downey, Calif.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-760.* 13 p. 5 refs. Contract No. NAS8-31324.

Mathematical models were developed for one-, two-, and three-stage radiator systems to determine optimum stage areas and system performance as a function of such parameters as insulation effectiveness, cold stage temperature, and heat load to the cold and intermediate stages. This study shows that multistage radiator systems can be optimized on the basis of weight or projected area, and that cold stage temperatures as low as 15 K are theoretically possible with present technology levels for insulation emittance. For the baseline design, analyses were performed to determine optimum radiator fin geometry and heat pipe spacing as a function of temperature, material properties, and heat pipe weight. In addition, a ground test system was designed for the baseline design with heat rejection requirements of 10 MW at 35 K on the cold stage and 100 MW at the second stage. (Author)

A77-37273 * # **Cryogenic temperature control by means of energy storage materials.** P. G. Grodzka, E. A. Picklesimer, and L. E. Connor (Lockheed Missiles and Space Co., Inc., Huntsville, Ala.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-763.* 8 p. 9 refs. Contract No. NAS8-31100.

An investigation was conducted to study the concept of thermal control by means of physical or chemical reaction heats for applications involving the storage of cryogens during long-term space voyages. The investigation included some preliminary experimental tests of energy storage material (ESM) effectiveness. The materials considered can store and liberate large amounts of thermal energy by means of mechanisms such as sensible heat, heat of fusion, and physical or chemical reaction heat. A differential thermal analysis was utilized in the laboratory tests. Attention is given to the evaluation of cryogenic ESM thermal control concepts, the experimental determination of phase change materials characteristics, and adsorption ESMs. It is found that an ESM shield surrounded by multiple layer insulation provides the best protection for a cryogen store. G.R.

A77-37280 * # **Re-entrant groove heat pipe.** W. Harwell (Grumman Aerospace Corp., Bethpage, N.Y.), W. B. Kaufman, and L. K. Tower (NASA, Lewis Research Center, Cleveland, Ohio). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-773.* 9 p. 14 refs.

This paper describes theoretical and experimentally verified heat pipe characteristics of an axially grooved aluminum extrusion with a re-entrant groove profile. The extrusion is 13 mm diameter with 20 axial grooves, each groove consisting of a nominal .8 mm diameter channel with a .2 mm wide passageway connecting the channel to the hollow core. A computer program was written to compute the zero gravity heat transport capability of the extrusion. A heat pipe was fabricated and its performance characteristics measured. The characteristics of the pipe with ammonia at 20 C are: zero gravity pumping limit 143 w-meters; static wicking height 21.5 mm; evaporator and condenser coefficients 7300 and 20,500 watt/sq m C, respectively. (Author)

A77-37281 # **Controllability analysis for passively and actively controlled heat pipes.** A. M. Lehtinen (Rockwell International Corp., Downey, Calif.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-776.* 13 p.

An analytical technique was developed for steady state and pseudo-transient control analysis of variable conductance heat pipes (VCHP) and feedback controlled heat pipes (FCHP). The approach uses a modified vapor temperature profile and a simple 5-node thermal network. This approach differs from past techniques in that it accounts for gas blockage of the adiabatic section and the set point temperature is referenced to the control point node rather than the vapor node. In FCHP systems, the gas inventory is determined at a design set point temperature and held constant for analysis of varying controller set point temperatures. The pseudo-transient analysis integrates the reservoir response time equations with the steady state control equations. The most significant findings were that reservoir volume increases due to controller set point, response time, and reservoir temperature limitations; and the existence of minimum and maximum controller set point temperatures when reservoir temperature limitations exist. (Author)

A77-37282 # **A precise satellite thermal control system using cascaded heat pipes.** W. H. Steele (McDonnell Douglas Astronautics Co., St. Louis, Mo.) and H. B. McKee (Frito-Lay, Inc., Irving, Tex.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-777.* 12 p. 6 refs.

A cascaded, dry reservoir, variable conductance heat pipe system was tested. Results show passive temperature control within plus or minus 0.5 deg F of the desired set point for a wide range of heat input and effective space environment temperatures. The use of long capillary tubes to isolate the reservoir and prevent set point temperature change due to cyclic heat loads and/or cyclic environment temperature was demonstrated. Orbit set point temperature control feasibility was investigated using variable volume control gas reservoirs. Set point temperature adjustment over a range from 50 F to 90 F was successfully achieved with high control accuracy. (Author)

A77-37283 * # **A structured surface for high performance evaporative heat transfer.** E. W. Saaski and R. H. Hamasaki (Sigma Research, Inc., Richland, Wash.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-778.* 9 p. 13 refs. NASA-supported research.

An evaporative surface is described for heat pipes and other two-phase heat transfer applications that consists of a hybrid composition of V-grooves and capillary wicking. Characteristics of the surface include both a high heat transfer coefficient and high heat flux capability relative to conventional open faced screw thread surfaces. With a groove density of 12.6/cm and ammonia working fluid, heat transfer coefficients in the range of 1 to 2 W/sq cm K have been measured, along with maximum heat flux densities in excess of

20 W/sq cm. A peak heat transfer coefficient in excess of 2.3 W/sq cm K at 20 W/sq cm was measured with a 37.8/cm hybrid surface. (Author)

A77-37630 EPA resource recovery demonstration - Summary of air emissions analyses. J. R. Holloway (U.S. Environmental Protection Agency, Resource Recovery Div., Washington, D.C.). *Waste Age,* vol. 7, Aug. 1976, p. 50-52.

Emissions tests on an experimental facility in St. Louis designed to produce shredded, air classified refuse-derived fuel (RDF) and on an associated power plant are discussed. The primary source of particulate emissions at the processing plant was found to be an air stream which transported the RDF through the air classifier. Second generation systems for commercial use incorporate emission control features to mitigate this problem. Although no attempt was made to determine the level of bacterial and virus emissions in working areas and at plant boundaries, large numbers of microorganisms were found in exhaust ducts of the air classifier and in the RDF storage bins. When RDF was fired with coal, no significant changes in nitrogen dioxide or sulfur dioxide emissions in comparison with coal-only regimes were observed. However, the average concentrations of chlorides in the stack were about 30% higher with combined RDF-coal firing. At boiler loads above 125 megawatts, an increase in the emission of controlled particulates was observed with combined firing. C.K.D.

A77-37646 Research needs report: Energy conversion research. New York, American Society of Mechanical Engineers, 1976. 134 p. 13 refs. $10.00.

The development and the use of nuclear breeder systems is considered. It is pointed out that current economically available supplies of uranium ores in the U.S. appear to limit the fueling of nuclear generation of electricity to only the next 20 to 30 years. The employment of nuclear breeder systems makes it possible to stretch the utility of the native ores considerably by converting conventional primary uranium and thorium to fissionable fuels. The direct burning and carbonization of coal in compliance with environmental protection controls is discussed and synthetic high BTU (pipeline quality) gas production is considered. Attention is given to a synthesis of low BTU gas from coal and residual oil, synthetic liquid fuel production, and the utilization of energy in waste materials. G.R.

A77-37652 Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. Symposium sponsored by the Institute of Gas Technology. Chicago, Institute of Gas Technology, 1976. 465 p. $40. (For individual items see A77-37653 to A77-37671)

Papers dealing with production of biomass for conversion to synthetic fuels with concomitant savings in materials and energy are presented. Major topics covered include: fundamentals of photosynthesis, scaled-up production of biomass, biomass-to-fuels conversion processes, characteristics and compositions of municipal and agricultural wastes, separation techniques, microbiological and anaerobic processes for production of gas from sewage effluents and other wastes, and economics of energy and materials recovery processes. Recovery of methane from landfill wastes, gas production from ocean kelp, microalgae, and water hyacinths, and reprocessing of cellulose to produce sugars and eventually alcohols are discussed. R.D.V.

A77-37653 Overview of energy supply and demand. W. W. Waterman (Institute of Gas Technology, Chicago, Ill.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 1-20. 9 refs.

A broad history of population expansion and expansion in consumption of primary fuels leads into an assessment of the rate of depletion of current fuel and energy resources on a worldwide scale. Recycling of materials, reduction in wastes volume, and efficient utilization of carbonaceous wastes to produce fuels are examined. Production of biomass and conversion of biomass to combustible gas and fluids are examined as routes to carbon fixation and making available fuel supplies based on solar energy utilization. Competing demands on hydrocarbons for materials production (lubricants, synthetic polymers and fibers, petrochemicals, dyes, medicines) are noted. R.D.V.

A77-37654 Wastes and biomass as energy resources - An overview. D. L. Klass (Institute of Gas Technology, Chicago, Ill.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 21-58. 18 refs.

Our national economy can be maintained on organic fuels by converting major sources of continuously renewable nonfossil carbon to synfuels that are interchangeable with, or can be substituted for, natural gas and petroleum-derived fuels. Promising sources of this carbon are waste materials, such as urban refuse, and biomass produced from solar energy by photosynthesis. The overview of the development of this concept presented in this paper points out the broad scope of the technology and its potential impact on U.S. energy supplies. The renewable feature of both wastes and biomass makes them valuable 'natural resources' that inevitably will be fully developed and commercialized as sources of energy-intensive products and synfuels. The perpetual availability of organic fuels will permit the conservation of our valuable fossil fuel reserves, and, as time passes, offer a long-term solution to independence from foreign energy supplies and fossil fuel depletion. (Author)

A77-37655 Municipal solid waste as a resource for energy recovery and conservation. H. Alter (National Center for Resource Recovery, Inc., Washington, D.C.). *(NCRR Bulletin,* vol. 5, no. 3, 1976.) In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 59-75. 37 refs.

Prospects for efficient and cost-effective utilization of municipal solid wastes (MSW) for fuel and materials recovery are assessed. Data referable to 1971 and extrapolations for 1974 are analyzed to find the energy potential of the waste stream generated; energy savings from materials recovery are taken into account. Plausible energy/materials conversion and substitution efficiencies are defined and analyzed in reference to the immediate future, and likely rates of implementation of new resources recovery plants are contemplated. Fluctuations in rates of energy and materials recovery from MSW are treated (predicted values). R.D.V.

A77-37656 Union Electric Company's 8000 ton per day solid waste utilization system. D. L. Klumb (Union Electric Co., St. Louis, Mo.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 77-88.

Full-scale testing of a solid waste utilization system (SWUS) in an existing pulverized-coal-fired utility boiler is described. A stream of 50,000 tons of municipal solid waste from the St. Louis residential area is processed to yield some 40,000 tons of burnable supplementary boiler fuel. The SWUS is scheduled to go on stream at full capacity of 8000 tons/day, 2.5 million tons/year, handling all of the solid waste generated in a 4500 sq. mile area in and around St. Louis, with a population of roughly 2.5 million. Flowsheets are displayed and refuse breakdown and composition figures are tabulated. Process steps are described and environmental impact is weighed. R.D.V.

A77-37657 Resource recovery and flash pyrolysis of municipal refuse. G. T. Preston (Occidental Research Corp., La Verne, Calif.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 89-114. 8 refs.

The Occidental Resource Recovery System is designed to be a low-pollution, low net cost technique for disposal of municipal refuse and recovery of its valuable energy and mineral constituents. Ferrous metals, clean glass cullet and an aluminum rich non-ferrous fraction are recovered as readily marketable commodities. The proprietary Flash Pyrolysis process, and pyrolytic oil product are discussed. The complete process will be demonstrated at a 200 ton per day plant now under construction in San Diego County, California. Other applications include production of a solid fuel from municipal refuse, pyrolysis of industrial organic wastes such as tree bark, and gasification of organic wastes by Flash Pyrolysis. (Author)

A77-37658 **Fuel gas and electricity from municipal sewage.** R. D. Bargman and J. M. Betz (City of Los Angeles, Los Angeles, Calif.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 115-121.

A gas containing 65% methane and 35% carbon dioxide can be produced in a sewage treatment plant by an established process. The gas can be utilized in internal combustion engines to produce power in quantities sufficient in many cases to sustain the plant's processes. The quantity of gas produced is small in comparison to the fuel needs of the community served by the treatment facility. The City of Los Angeles has operated for the past 25 years a 140,000 KWH/day diesel engine power plant utilizing gas produced at the Hyperion Treatment Plant. The gas provides 94% of the fuel requirements of the engines. (Author)

A77-37659 **SNG from refuse and sewage sludge by the BIOGAS process.** S. Ghosh and D. L. Klass (Institute of Gas Technology, Chicago, Ill.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 123-181. 19 refs.

Laboratory, small pilot, and field work on the development of a process for the gasification of municipal solid wastes and sewage sludge has had a number of objectives. These include increasing the production of methane and the solids destruction efficiency; cost reduction; evaluating, selecting, and integrating unit operations; and improving the overall process design. Out of this work has evolved BIOGAS, a family of process designs for disposal of combined refuse and sludge wastes and for the production of SNG and recyclable products. We have concluded that the next logical step in this program is to demonstrate the technology in a 100-ton/day plant to confirm our findings and to justify full-scale plant operations. (Author)

A77-37660 **Synthetic natural gas from animal wastes by anaerobic fermentation.** R. W. Douglas (ERA, Inc., High-Plains, Tex.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 183-196. 8 refs.

The feasibility of industrial processes for digestion of wastes by anaerobic micro-organisms to produce synthetic natural gas (SNG) is examined. Municipal and animal husbandry wastes (wastes produced via concentrated cattle, poultry, and swine feedlots) are likely sources of ecologically harmful wastes that can be degraded via microbiological processes. Attention is centered on the HYMETH (high-quality methane gas) proprietary process which yields 98% (or higher) methane gas of pipeline quality from cattle feedlot wastes; obviating a scrubbing step renders the process even more cost-effective. R.D.V.

A77-37661 **Fuel gas from landfill.** R. T. Mandeville (Reserve Synthetic Fuels, Inc., Newport Beach, Calif.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 197-204.

Recovery of methane as a low BTU gas fuel from refuse landfills is assessed. While landfill gas recovery would cover only a modest fraction of natural gas demand, it would constitute a renewable energy source not to be overlooked. A molecular sieve pressure swing adsorption process is recommended for expediting landfill gas cleanup. R.D.V.

A77-37662 **The conversion of ocean farm kelp to methane and other products.** T. M. Leese (U.S. Naval Weapons Center, China Lake, Calif.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 253-266. 13 refs. Research sponsored by the American Gas Association and ERDA.

A process for in situ conversion of giant California kelp (Macrocystis pyrifera) into fuel and useful byproducts is described. Reliance on solar energy to produce biomass is expected to minimize ecological impact, with no net energy increase in the earth's atmosphere or immediate waters. Terrestrial fertilizer, feed supplements for meat-producing animals, and miscellaneous industrial products are envisaged as byproducts. R.D.V.

A77-37663 **An economic assessment of fuelgas from water hyacinths.** R. P. Lecuyer (United Technologies Florida Research and Development Center, West Palm Beach, Fla.) and J. H. Marten (Davy Powergas, Inc.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 267-286. 12 refs.

An economic study is presented to produce 200 million scf/day of methane using water hyacinths as a feedstock. The water hyacinths are grown in a controlled area, harvested by a unique process and converted to a 600 Btu/scf biogas through an anaerobic digestion process. The biogas is then upgraded to methane by removal of carbon dioxide gas from the biogas using the Benfield process. The approximate 1000 Btu/scf Pipeline Quality Gas (PQG) is then compressed to pipeline pressure and sold to a gas pipeline company or large industrial user(s). Water hyacinths were selected as a feedstock because of their prolific growth rate (60 dry tons/acre/year), absence of a current economic value and ease of harvesting since they are floating plants. The results of the analysis indicate that the process is ecologically sound, technically feasible, and economically near-viable in an increasing natural gas cost economy, but possibly questionable from a public acceptance standpoint because of the large land area required. (Author)

A77-37664 **Energy from agriculture.** J. A. Alich, Jr. and R. E. Inman (Stanford Research Institute, Menlo Park, Calif.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 287-309.

The contribution of bioconversion via solar energy utilization to the national energy supply is estimated at about 8% by the end of the century, assuming implementation of plans projected in the Project Independence blueprint report. Four sources of biomass are contemplated: urban solid wastes, agricultural residues, terrestrial energy crops, and marine energy crops. Attention is centered on terrestrial crops; species recognized as suitable biomass resources include: sugar cane, sorghum, kenaf, sunflower, forage grasses, alfalfa, bamboo, and some trees (poplar, sycamore, eucalyptus, larch, pitch pine, beech). Plantation sitings are discussed, and projections of natural gas yields and electric power production via combustion of biomass are attempted. R.D.V.

A77-37665 **Gas production from micro algae.** W. J. Oswald (California, University, Berkeley, Calif.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the

Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 311-324. 7 refs. NSF Grant No. GI-39216; Contract No. W-7405-eng-48.

An integrated solid waste and algal bio-gas facility in which combustion of dry wastes could be used to generate power, release CO2 for algae and heat the digesters is described. An area of about 68 million hectare would meet the gaseous energy needs of the United States in the year 2000. The energy would have a net cost of more than $2 per million BTU but it would be environmentally clean, pollution free and eternally available. Crucial research needs are to seek improved photosynthetic efficiency, improved species and species control, more economical methods of harvesting algae and a method of integrating nutrients for continuous algal growth.
(Author)

A77-37666 Enzymatic hydrolysis of cellulosic wastes to fermentable sugars for alcohol production. L. A. Spano (U.S. Army, Food Sciences Laboratory, Natick, Mass.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 325-348. 21 refs.

Cellulose, produced worldwide in amounts estimated at 100 billion tons annually in the wood and paper and pulp industries, and in agricultural wastes, is studied as a source for production of industrial alcohols via enzymatic hydrolysis to sugars. The cellulose-derived sugars can then be used as chemical feedstocks in existing petrochemical processes, or as nutrients and growth media for microbiological production of food for animals or humans. Pilot plant studies of cellulose treatment processes, specifically production of cellulase enzyme via submerged fermentation involving Trichoderma viride, are described. Production volumes and estimated process costs and returns are discussed. R.D.V.

A77-37667 Design, operation and economics of the energy plantation. M. D. Fraser, J.-F. Henry, and C. W. Vail (InterTechnology Corp., Warrenton, Va.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 371-395. 9 refs. Grant No. DACA23-74-C-0009.

The energy plantation concept considered represents an innovative, systematic approach for producing a practical and economic fuel from plant matter on a large scale. Ultimately, the fuel derives from solar energy, which is collected and stored in plants grown for their fuel value. The advantages of energy plantations are examined and questions regarding the plant resources are investigated. Attention is given to natural stands versus managed plantings, annual plants versus perennials, deciduous plants versus conifers, preferred deciduous species, and preferred perennial grasses. Suitable land resources are considered along with plant-matter production rates, plantation design and operation, and the economics of the energy plantation. G.R.

A77-37668 EPA's program in environmental research in wastes-as-fuel. G. L. Huffman (U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Cincinnati, Ohio). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 397-412. 14 refs.

The EPA research program concerning wastes as fuel is discussed. The four main components of the program involve: (1) technical, economic, and environmental assessments, (2) waste co-firing with coal, oil, or industrial waste, (3) waste co-combustion with sewage sludge, and (4) pyrolysis and bioconversion processes. It is estimated that the 570 million tons of dry combustible solid waste discarded each year by municipalities, agriculture, and industry represent an energy loss of about 12 per cent of the U.S. energy requirement. Due to the geographical dispersion of much of this waste, it is thought that perhaps only 1.5 to 3.0 per cent of the total energy requirement (1 to 2 quads, i.e., 1 to 2 quadrillion Btu/yr) is potentially recoverable, although this percentage might increase if fuel prices increase substantially. Research projects are described. M.L.

A77-37669 Environmental studies of the St. Louis-Union Electric refuse firing demonstration. J. D. Kilgroe (U.S. Environmental Protection Agency, Industrial Environmental Research Laboratory, Research Triangle Park, N.C.), L. J. Shannon, and P. Gorman (Midwest Research Institute, Kansas City, Mo.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 413-426. 8 refs.

The use of shredded municipal solid waste as a supplementary fuel in a pulverized coal-firing utility boiler is studied with regard to the refuse processing plant dust emissions and noise, stack particulate and gaseous stack emissions, and boiler ash pond effluent. Residential solid waste was processed by a hammermill and then air-classified into light and heavy fractions. The light fraction, which is the refuse-derived fuel (RDF), represents about 2/3 or 3/5 of the available higher heating value of the waste. The properties of RDF and Orient 6 coal are compared. Use of RDF results in moderately increased Cl- but not SO2, NOx, or CO emissions, reduces the collection efficiency of the electrostatic precipitators at loads above 100 MW primarily because of higher gas flow volumes, and increases water pollution levels for several pollutants in the ash pond. Other data are presented and discussed. M.L.

A77-37670 Federal Fuels from Biomass Energy Program. R. F. Ward (ERDA, Washington, D.C.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 427-436. 6 refs.

The paper surveys federal research concerned with developing fuels from biomass. Biomass production studies deal with the growing, harvesting, and collection of agricultural, feedlot, and forestry residues. Biomass conversion procedures involve biological techniques (aerobic digestion, acid hydrolysis, enzyme hydrolysis, biophysics) and thermochemical techniques (pyrolysis and hydrogasification) as well as direct combustion. Field crops and tree crops considered potential feedstocks for conversion to fuels are listed. The use of kelp is examined. Waste utilization, which could involve manure, agricultural crop and food wastes, logging and wood manufacturing residues, or urban solid wastes, is discussed. The research and development implementation strategy is described with attention to research categorization and the scheduling of research projects. M.L.

A77-37671 The PUROX System. T. F. Fisher, M. L. Kasbohm, and J. R. Rivero (Union Carbide Corp., Linde Div., Tonawanda, N.Y.). In: Clean fuels from biomass, sewage, urban refuse, agricultural wastes; Proceedings of the Symposium, Orlando, Fla., January 27-30, 1976. (A77-37652 17-44) Chicago, Institute of Gas Technology, 1976, p. 447-459.

The PUROX System employs a partial oxidation process using oxygen for converting municipal solid waste to fuel gas and inert slag. The operation of a 200 ton/day facility is described. In approximate figures, one ton of refuse requires about 0.2 ton of oxygen and produces 0.7 ton of medium Btu fuel gas, 0.22 ton of sterile residue and 0.28 ton of wastewater. Refuse, preprocessed for recovery of iron and other materials, is fed to the top of a vertical shaft furnace through a gas seal and oxygen is injected into the bottom hearth section. The reaction of oxygen with char formed from the particles of refuse generates high temperatures which melts glass, metal and other materials. Hot gases from this process are used to pyrolyze the refuse and the resulting fuel gas is cleaned. A gas analysis and slag analysis are provided, and several features of the system are discussed. M.L.

A77-37765 // Some questions concerning the creation of a solar thermionic converter system (Nekotorye voprosy sozdaniia solnechnoi termoemissionnoi energeticheskoi ustanovki). E. I.

Grigor'ev, V. M. Zaitsev, M. V. Mel'nikov, O. A. Nevezhin, V. S. Ovchinnikov, V. P. Poluektov, S. V. Riabikov, I. M. Rubanovich, S. A. Khudiakov, and E. M. Iurin (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Istochnikov Toka, Moscow, USSR). *Geliotekhnika*, no. 2, 1977, p. 9-16. In Russian.

Apparatus is described for testing thermionic converters in laboratories or in the presence of solar radiation. Experiments involving high-temperature steady-state systems are explained. Volt-ampere characteristics, the effect of cathode temperature, the relation between incident and converted energy, and the effect of the reflection coefficient of the mirror were studied. M.L.

A77-37767 # Geometric perfection of matrix polyurethane foam moldings for solar energy concentrators (Issledovanie geometricheskogo sovershenstva matrichnykh penopoliuretanovykh kopii dlia kontsentratorov solnechnoi energii). B. A. Bazarov, V. M. Kapeliushnikov, and B. A. Kalinin (Akademiia Nauk Turkmenskoi SSR, Fiziko-Tekhnicheskii Institut, Ashkhabad, Turkmen SSR). *Geliotekhnika*, no. 2, 1977, p. 25-29. 7 refs. In Russian.

The integral energy distribution of moldings of a solar energy concentrator was compared with that of the original as a method of assaying the precision of duplication. The original was made of glass. The copies were made of polyurethane foam combined with either mosaic glass or polytetrafluoroethylene reflecting films. Short-circuit currents, concentrating capacities, diameters of the focal spots, and the extent of precision are compared. M.L.

A77-37768 # Concentration of scattered radiation (Kontsentratsiia rasseiannogo izlucheniia). V. K. Baranov. *Geliotekhnika*, no 2, 1977, p. 30-36. 5 refs. In Russian.

A parabolic-toroid solar concentrator and a parabolic-cylindrical solar focusing lens are described. The ability of these focusing devices to concentrate diffuse light from a large source, as from the sun, is considered. An analytical relationship is obtained for the average flux density in the small aperture in terms of the flux density incident at the large aperture. In comparison with lens systems, the focusing concentrator concentrates a much larger amount of diffuse light. M.L.

A77-37769 # Analysis of a faceted concentration system (Analiz fatsetnykh kontsentriruiushchikh sistem). R. A. Zakhidov (Akademiia Nauk Uzbekskoi SSR, Tsentral'noe Proektno-Konstruktorskoe Biuro Nauchnogo Priborostroeniia, Tashkent, Uzbek SSR) and A. Sh. Khodzhaev (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 2, 1977, p. 37-42. 17 refs. In Russian.

Calculation procedures for faceted solar concentration systems are analyzed. The distribution of illumination in the focal volume of the long-focus mirror or facet is studied. The plane in which maximal illumination is obtained does not in general coincide with the focal plane of the facet, since the position of the plane depends on the angle between the facet and the light source. Methods for calculating facet focal parameters are proposed. M.L.

A77-37770 # Solar energy systems of the tower type - Arrangement and heat-stability of the receivers and steam generators (SES bashennogo tipa - Komponovka i stabil'nost' teplovykh rezhimov priemnikov-parogeneratorov). D. I. Tepliakov and R. R. Aparisi (Gosudarstvennyi Nauchno-Issledovatel'skii Energeticheskii Institut, Moscow, USSR). *Geliotekhnika*, no. 2, 1977, p. 43-55. 9 refs. In Russian.

A graphic method of calculating the illumination on cylindrical receivers and steam generators is presented and demonstrated for planar axisymmetric and planar eccentric arrangements. Daily thermal deviations in the ray-receiving surface are caused by changes in the geometry and magnitude of direct solar radiation. M.L.

A77-37771 # Study of the characteristics of convective heat transfer in cylindrical solar energy receivers by solving the conjugate problem of heat exchange (Issledovanie kharakteristik konvektivnoi teplootdachi v tsilindricheskikh geliopriemnikakh na osnove resheniia sopriazhennoi zadachi teploobmena). I. A. Rozhkov and V. A. Grilikhes. *Geliotekhnika*, no. 2, 1977, p. 56-63. 7 refs. In Russian.

A77-37772 # Study of an absorption solar refrigeration unit functioning on a round-the-clock basis (Issledovanie absorbtsionnogo geliokholodil'nika kruglosutochnogo deistviia). A. T. Vakhidov and T. M. Maksudov (Samarkandskii Kooperativnyi Institut, Samarkand, Uzbek SSR). *Geliotekhnika*, no. 2, 1977, p. 64-67. In Russian.

A solar refrigeration unit using a water-ammonia solution is described. The variation of temperature and pressure parameters during continuous operation is examined, and the different events occurring in the presence or absence of illumination are explained. M.L.

A77-37773 # Development and testing of solar water-heating boilers manufactured by diffusion welding (Razrabotka i ispytanie solnechnykh vodonagrevatel'nykh kotlov, izgotovlennykh metodom diffuzionnoi svarki). G. Ia. Umarov, F. Soatov, R. R. Avezov, Iu. M. Sigalov, and N. I. Koriagin (Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 2, 1977, p. 68-70. In Russian.

A77-37774 # Solar heating in residential houses in Uzbekistan (Solnechnoe otoplenie v zhilykh domakh Uzbekistana). L. F. Aksenov, I. Ia. Viron, R. R. Avezov, O. L. Shvaleva, and A. M. Gafurov (Uzbekskii Nauchno-Issledovatel'skii Institut Gradostroitel'stva; Akademiia Nauk Uzbekskoi SSR, Fiziko-Tekhnicheskii Institut, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 2, 1977, p. 71-74. 5 refs. In Russian.

A77-37775 # Modeling algorithms and their implementation on a digital computer for calculating the capacity of storage cells at wind-power and solar energy installations (Modeliruiushchie algoritmy i ikh realizatsiia na ETsVM dlia rascheta emkosti akkumuliruiushchikh ustroistv vetro- i gelioustanovok). R. B. Salieva (Tashkentskii Elektrotekhnicheskii Institut Sviazi, Tashkent, Uzbek SSR). *Geliotekhnika*, no. 2, 1977, p. 75-83. 6 refs. In Russian.

A77-37927 # Investigation of the 'crisis' of heat and mass transfer in low-temperature wickless heat pipes (Issledovanie krizisa teplomassoperenosa v nizkotemperaturnykh besfitil'nykh teplovykh trubakh). M. K. Bezrodnyi and D. V. Alekseenko (Kievskii Politekhnicheskii Institut, Kiev, Ukrainian SSR). *Teplofizika Vysokikh Temperatur*, vol. 15, Mar.-Apr. 1977, p. 370-376. 9 refs. In Russian.

In the experiments described, the maximal heat transfer capacity of closed two-phase thermosiphons was studied as a function of the geometrical parameters of the adiabatic zone, the heat supply and heat release geometry, the type of working fluid, the pressure in the inner cavity, and the content of heat transfer agent in the cavity. Water, methyl alcohol, Freon-11, Freon-113, and Freon-12 were used as the working fluid. The test results are generalized and are used to plot the maximal (critical) heat flux density against the content of heat transfer agent and other thermosiphon parameters for each of the fluids tested. V.P.

A77-37929 # Limiting values of the energy generated by pulsed MHD-converters (K voprosu o predel'nykh znacheniiakh energii, generiruemoi impul'snymi MGD-preobrazovateliami). O. S. Popel' and O. A. Sinkevich (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplofizika Vysokikh Temperatur*, vol. 15, Mar.-Apr. 1977, p. 385-389. 8 refs. In Russian.

The energy characteristics of pulsed MHD energy converters operating at active and inductive loads are analyzed over a wide range of magnetic Reynolds numbers. The limiting values of the power extractable from the flow are determined as a function of such converter parameters as the channel dimensions; plasma velocity and

conductivity; and magnetic field induction. The optimal values of the active and inductive loads are identified. V.P.

A77-37930 # **Investigation of two-dimensional electric effects in a sectional MHD-channel (Issledovanie dvumernykh elektricheskikh effektov v ramochnom MGD-kanale).** V. A. Bitiurin, B. M. Burakhanov, V. A. Zhelnin, V. I. Kovbasiuk, T. N. Kuznetsova, and S. A. Medin (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). *Teplofizika Vysokikh Temperatur,* vol. 15, Mar.-Apr. 1977, p. 390-398. 13 refs. In Russian.

The present paper deals with the characteristics of sectional MHD-channels in which electrical conductivity and flow rate is nonuniformly distributed over the channel cross section. A numerical method is proposed for solving the electrodynamic problem in parametric form. This makes it possible to analyze the electrical characteristics of the channel on the basis of a solution of an elliptic equation. The influence of the plasma parameters on the characteristics of the channel is assessed, and the latter are compared with those of an equivalent Faraday channel. The comparison shows that the influence of two-dimensional electric effects in a diagonal MHD generator do not exceed those of a Faraday generator. V.P.

A77-37939 **Stack gas cleanup.** J. Papamarcos. *Power Engineering,* vol. 81, June 1977, p. 56-64.

Flue gas scrubber systems for use with high-sulfur coal are discussed, and data are provided on the number of each system which are operational, in construction, or in the planning stage. Costs are considered with reference to alternate coal-burning procedures which do not result in high sulfur emissions. It is suggested that many utilities have no near-term alternative to stack gas scrubbing if they are to meet air standards. The performance of some double-alkali systems is evaluated. Aspects of flue-gas desulfurization procedures are examined with attention to expense factors, reliability, and the likelihood of technological improvements. M.L.

A77-37949 # **Fundamentals of aerodynamic design: Propellers /2nd enlarged edition/ (Osnovi aerodinamickih konstrukcija: Elise /2nd enlarged edition/).** M. Nenadovic. Belgrade, Univerzitet u Beogradu, 1976. 671 p. 37 refs. In Serbo-Croatian.

Basics of the mechanical and aerodynamic design of propellers, for piston engines, turboprop engines, wind-tunnel propeller groups, hovercraft, windmills, and wind-powered generators are presented, with extensive graphical and numerical data on various types of propellers and propeller systems, wind-tunnel studies, airfoil aerodynamic design, and similarity studies. Many numerical examples are discussed and worked out for existing aircraft and propeller system designs. Interaction between propellers and other aircraft parts, tractor propellers and pusher propellers, variable-pitch and fixed-pitch propellers, ducted propellers, and tandem propellers are discussed, along with propeller dynamics at supersonic speeds. Detailed attention is given to devices for varying propeller pitch in flight. R.D.V.

A77-37960 * # **Future trends in electrical energy generation economics in the United States.** R. W. Schmitt, G. R. Fox, R. P. Shah, P. J. Stewart, and D. A. Vermilyea (General Electric Co., Schenectady, N.Y.). *Ministry for Electrical Engineering Industries of USSR and Academy of Sciences of USSR, World Electrotechnical Congress, Moscow, USSR, June 21-25, 1977, Paper.* 49 p. 7 refs. Contract No. NAS3-19406.

Developments related to the economics of coal-fired systems in the U.S. are mainly considered. The historical background of the U.S. electric generation industry is examined and the U.S. electrical generation characteristics in the year 1975 are considered. It is pointed out that coal-fired power plants are presently the largest source of electrical energy generation in the U.S. Questions concerning the availability and quality of coal are investigated. Currently there are plans for converting some 50 large oil and gas-fired generating plants to coal, and it is expected that coal will be the fuel used in almost all fossil-fired base load additions to generating capacity. Aspects of advanced energy conversion from coal are discussed, taking into account the performance and economic potential of the energy conversion systems. G.R.

A77-38006 **Flight test development of a helicopter-towed surface delivery system.** J. H. Edris and G. E. Clarke (U.S. Navy, Naval Air Test Center, Patuxent River, Md.). In: The many disciplines of flight test; Proceedings of the Seventh Annual Symposium, Eastsound Orcas Island, Wash., August 4-6, 1976. (A77-38003 17-05) Lancaster, Calif., Society of Flight Test Engineers, 1976, p. 4-1 to 4-14.

The article describes a flight test program for a fast delivery system (FDS) sled for prompt overwater delivery of antipollution equipment to offshore or remote locations to deal with offshore oil spills. The mass of the towed surface vessel in this case is equal to or greater than the mass of the towing helicopter. Quick automatic release and manual overrides are described. Dynamic and static tow tests, effects of wind and skew angle, sled planing tension, and various towing techniques are discussed. A linear low-speed regime similar to hover performance in winds, and a high-speed regime similar to normal level-flight performance polars, are discerned. Sled performance was governed by gross sled weight and by sled center of gravity (respectively, tension and planing). R.D.V.

A77-38049 **N-indium tin oxide/p-indium phosphide solar cells.** K. S. Sree Harsha, K. J. Bachmann, P. H. Schmidt, E. G. Spencer, and F. A. Thiel (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). *Applied Physics Letters,* vol. 30, June 15, 1977, p. 645, 646. 11 refs.

N-indium tin oxide/p-indium phosphide (n-ITO/p-InP) solar cells have been prepared by ion-beam deposition of indium tin oxide on p-InP single-crystal substrates. The cells have a solar power conversion efficiency of 14.4% at air mass 2 when provided with antireflection coatings. (Author)

A77-38100 **COGAS status report.** W. A. Paige (COGAS Development Co., Princeton, N.J.). *(Conference on Synthetic Fuels from Coal, 5th, Oklahoma State University, Stillwater, Okla., May 5, 6, 1975.) Energy Communications,* vol. 3, no. 2, 1977, p. 127-150. 7 refs.

The COGAS Process provides a way to produce clean liquid fuels and moderate or high Btu gas from coal. It integrates multi-stage coal pyrolysis and steam gasification of char, with heat provided by a separate air-blown combustor. It derives advantages from: the co-production of oil, use of low pressure, carbon efficiencies, avoidance of oxygen, and emphasis on demonstrated technology. Two gasification pilot plants have been built and operated to evaluate inert heat carrier vs char heat carrier. The char heat carrier process, piloted in England, has demonstrated very promising performance and has been selected for continued development. The program is now proceeding toward design and construction of large pilot plant of 600-1000 TPD coal capacity. (Author)

A77-38121 **An application of the economic-environmental power dispatch.** J. Zahavi (Tel Aviv University, Tel Aviv, Israel) and L. Eisenberg (Pennsylvania, University, Philadelphia, Pa.). *IEEE Transactions on Systems, Man, and Cybernetics,* vol. SMC-7, July 1977, p. 523-530. 22 refs.

An application of a decision approach for controlling air pollution emission from power generation is described. Trade-off curves between pollution emission and total operating cost are first computed for a portion of a realistic system containing coal, oil, and gas turbine generation. Points on the trade-off curve are then mapped into an exposure measure by using an air pollution diffusion model for the region being analyzed. The computations were carried out for several demand levels and various weather conditions. A comparative analysis of the results and their implications to power dispatch decisions are discussed. (Author)

A77-38146 Progress on the selective removal of H2S from gasified coal using an immobilized liquid membrane. S. L. Matson, C. S. Herrick, and W. J. Ward, III (GE Corporate Research and Development Center, Schenectady, N.Y.). *I & EC - Industrial and Engineering Chemistry, Process Design and Development,* vol. 16, July 1977, p. 370-374.

Combined cycle power generation plants fired by low Btu gasified coal will be among the most efficient, environmentally acceptable means of coal-based power generation available. A major cost of producing clean gasified fuel from high sulfur coal is associated with H2S removal and conversion to sulfur. A new approach now under development to H2S removal is based on an immobilized HCO3(-)/CO3(2-) membrane through which facilitated transport of H2S occurs. The membrane has sufficiently high H2S permeability to be a candidate for economical industrial application. A membrane configuration has been devised which provides a degree of 'H2S/CO2 selectivity not available with conventional hot carbonate scrubbers. Thus the prognosis for an economical, efficient membrane H2S scrubber is favorable, although much development has yet to be done to prove the viability of the concept. (Author)

A77-38178 Computer model of a solar-assisted heating design approach implemented on a minicomputer installation. R. D'Ippolito and R. Krutz (Carnegie-Mellon University, Pittsburgh, Pa.). In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976. Part 1. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 31-34.

Solar energy heating simulation and life cycle cost estimation programs have traditionally been designed to run on relatively large computer installations with resulting accrual of costs for yearly runs with many iterations. The objective of the work described in this paper is to develop techniques to permit accurate simulation and estimation programs to be executed on minicomputer installations available at most facilities. Techniques applied to determination of driving functions and system modeling for a flat-plate collector-based solar heating system are described. (Author)

A77-38207 An optimization approach to the design of the preheater for a magnetohydrodynamic powerplant. T. Coultas, M. Minkoff (Argonne National Laboratory, Argonne, Ill.), L. Cornwell (Western Illinois University, Macomb, Ill.), and H. Schultz (Wisconsin, University, Oshkosh, Wis.). In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976. Part 1. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 586-589. ERDA-sponsored research.

A mixed integer nonlinear programming model of a regenerator for preheating air in the magnetohydrodynamic energy conversion process is presented. The model is an extension of a computer simulation which was used initially and results are given illustrating significant design improvements due to the use of mathematical programming. The model of seven constraints (all highly nonlinear) in four variables (one integer) is solved using a nonlinear programming code. (Author)

A77-38208 Sandia studies for ERDA central receiver thermal electric power project. P. J. Eicker and J. M. Brune (Sandia Laboratories, Livermore, Calif.). In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976. Part 1. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 632-635.

Studies underway for the ERDA central solar thermal electric pilot plant project are outlined. The factors under consideration in evaluations of the economic impact of the central receiver solar thermal power system are discussed. Procedures used in margin analysis and transient response analysis are described, together with the system operation model and mirror field models. C.K.D.

A77-38209 Conceptual heliostat field design for the ERDA 5 Megawatt Solar Thermal Test Facility at Sandia, Albuquerque. K. L. Curtner, E. M. Fourakis, and P. D. Mitchell (Honeywell Energy Resources Center, Minneapolis, Minn.). In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976. Part 1. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 636-640.

The working heliostat field for the ERDA 5 Megawatt Solar Thermal Test Facility was designed to meet the solar thermal power requirements for testing 4 different receiver subsystem research experiments. Requirements for the field were specified in terms of yearly solar thermal energy available from the heliostats and instantaneous power levels delivered by the heliostat field to the experiments. A ray-trace simulation model of the subsystem research experiment receivers and heliostat field was the principal tool used in this conceptual design. Field deployment, focusing strategy, number of heliostats and total mirror area required to accomplish the test objectives of the facility were established. (Author)

A77-38210 Modeling aspects of a gas turbine solar-electric power system. E. J. McBride (Black and Veatch Consulting Engineers, Kansas City, Mo.) and P. D. Mitchell (Honeywell Systems and Research Center, Minneapolis, Minn.). In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976, Part 1. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 641-645.

For the conceptual design of a high-temperature solar electric plant, two mathematical models and associated computer software have been developed. One, the solar central receiver model, analyzes the performance of various combinations of collector field and central receiver geometries in terms of gross power received and power flux maps on the receiver walls. The second model, heat exchanger and cavity analysis, evaluates the microscopic performances of the heat transfer surfaces and uses the results to evaluate the macroscopic performance of the receiver cavity as a whole. M.L.

A77-38211 * Conceptual design of a parabolic dish solar collector using simulation techniques. B. P. Gupta and R. L. Buchholz (Honeywell Energy Resources Center, Minneapolis, Minn.). In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976. Part 1. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 646-650. Contract No. NAS3-19740.

The development of solar concentrators in recent years have produced a wide variety of collectors for the utilization of solar energy. This paper presents the simulation techniques used to predict the optical and thermal performance of a paraboloid of revolution type solar collector. Conceptual design of a dish concentrator with a fixed receiver size is obtained by parametrically examining the significant variables. (Author)

A77-38213 An integrated process model of the Fischer-Tropsch process for liquid fuels production from coal. M. A. Hissam and D. G. Nichols (West Virginia, University, Morgantown, W. Va.). In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976. Part 1. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 671-675. 8 refs. NSF Grant No. GI-38331.

This paper deals with the development of a computer model of the Fischer-Tropsch process. On the basis of an integrated process flow scheme, the model generates capital and operating cost information. The model should prove valuable for use in the study of hydrocarbon liquids synthesis to help alleviate our energy shortage. (Author)

A77-38215 International energy demand model - Twenty OECD country models. D. Cato and E. Reiser (Federal Energy Administration, Washington, D.C.). In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976. Part 2. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 923-928.

The general features of an energy demand model forecasting the demands for final energy products of 20 OECD countries are described. The demand sectors are transportation, manufacturing, residential/commercial, other petroleum, nonenergy petroleum, and energy sector. The model structure for the first three sectors is identical, and has the following heuristic interpretation: consumers first determine a total BTU budget based on the level of energy prices, incomes, and past behavior, and then determine fuel choice on the basis of relative prices and past behavior. Slope parameter and t-statistics obtained by pooled cross-section time series estimation are given. P.T.H.

A77-38216 International energy evaluation system. J. D. Pearson, S. W. Edwards, C. Everett, W. C. Kilgore, and E. Tukenmez (Federal Energy Administration, International Analysis Div., Washington, D.C.). In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976. Part 2. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 929-936.

A detailed model of the equilibrium international flows of energy in the primary forms of coal, natural gas, and crude oil was constructed in order to aid in the prediction of the effect of various national and international policies on the energy flows into and around the U.S. and its allies. The world is divided into 20-30 regions, each interconnected to distribute primary energy and energy products via various kinds of tanker and bulk carriers. There are several submodels. The demand model calculates final consumption demands for refined oil, coal, etc. as function of energy prices. The supply models calculate supplies of primary energy materials as functions of their prices. The conversion technology models, representing refining and electrical generation activities, provide links between primary and material supplies and product demands. The transportation models simulate international movements of energy resources between the regions in 11 transportation modes. The market clearing mechanism is an iterative procedure for generating the equilibrium solutions of the model. P.T.H.

A77-38217 A derived demand model of energy demand in the transportation sector. M. Rodekohr and L. Rubin (Federal Energy Administration, Washington, D.C.). In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976. Part 2. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 937-942. 9 refs.

In this paper we present a derived demand econometric model of energy consumption in the transportation sector. Each fuel, gasoline, distillate residual, jet fuel, liquefied gases and coal are modeled separately with various procedures depending on the availability of data. We show that interfuel substitution possibilities are limited in the transportation sector. We also show the importance of the capital stock in the various demand functions. The capital stock and the intensity of utilization of the stock play a central role in the determination of the demand for energy in the transportation sector. (Author)

A77-38218 Energy R&D modeling for budgetary decisions. K. Chen, J. Lathrop, C. Kirkwood, and S. Pollock (Michigan, University, Ann Arbor, Mich.). In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976. Part 2. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 955-962. 23 refs. NSF Grant No. ENG-74-22564.

A top-down approach is taken to apply multi-objective decision analysis to the strategic budgetary decisions in energy RD&D (research, development and demonstration) planning. A model is developed for the explicit and quantitative treatment of uncertainties and project interrelationships. The model is applied to an example budgetary allocation between two coal liquefaction programs, H-Coal and Synthoil. The example demonstrtes the potential appropriateness of decision analysis in energy RD&D strategic planning. (Author)

A77-38220 A United States energy model economically driven by a global growth simulation. J. F. Alexander, Jr., N. G. Sipe, and H. T. Odum (Florida, University, Gainesville, Fla.). In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976. Part 2. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 1013-1019. 13 refs. Contract No. E(40-1)-4398.

Dual dynamic mini-models of the world and the United States were developed to simulate United States growth trends. The models were developed using energy language diagrams and concepts developed by H. T. Odum. The models were simulated from 1954 through 2054 using DYNAMO II simulation language. Equations, symbols, and systems diagrams are presented and explained. (Author)

A77-38221 The Energy Supply Planning Model - A working tool for regional analysis of alternative national energy policies. M. Carasso and J. M. Gallagher (Bechtel Corp., San Francisco, Calif.). In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976. Part 2. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 1041-1048. NSF-supported research.

The paper describes the general features and capabilities of the Energy Supply Planning Model - a quantitative tool developed for aiding in the evaluation of the feasibility of various proposed U.S. energy scenarios in terms of specific societal resources required for the construction and operation of energy supply and energy transportation facilities needed to implement these scenarios. Given a candidate future energy mix of interest, the model computes by year the number of new energy facilities of various types that must be brought on-stream to supply the mix. Given user specification, the model then locates the facilities in one of 14 regions of the U.S., allocates fuels to the demand of the 11 land regions, and calculates transportation facilities required. Direct capital, manpower, and materials needed and when they are needed are then calculated. P.T.H.

A77-38222 A solar heating system simulation model. A. H. Eltimsahy (Toledo, University, Toledo, Ohio) and C. H. Copass. In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976. Part 2. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 1092-1097.

A simulation model for a solar heating system which is suitable for control and optimization studies is developed. The effect of temperature stratification in the heat storage device model is considered by simulating two storage chambers of variable volume. The gradient search method is applied to study optimal sizing of solar heating components for the University of Toledo solar house. (Author)

A77-38224 * Experimental solar heating-cooling system model tests of a full-scale building system. D. Namkoong (NASA, Lewis Research Center, Cleveland, Ohio). In: Modeling and simulation. Volume 7 - Proceedings of the Seventh Annual Pittsburgh Conference, Pittsburgh, Pa., April 26, 27, 1976. Part 2. (A77-38176 17-66) Pittsburgh, Pa., Instrument Society of America, 1976, p. 1103-1113. 10 refs.

An experimental solar heating and cooling system model has been built and operated, combining elements that are programmable - heating and/or cooling load of a building, collected solar energy - with experimental equipment. The system model was based on the loads and components used in the Solar Building Test Facility (SBTF) which includes a 1394 square meter solar collector field, at NASA-Langley. Operations covered 5 continuous days under summer conditions. For the system model, up to 55% of the simulated collected solar energy was used for the building load. This amount constituted 35% of the building cooling load. Heat loss was significant. If tank heat loss were eliminated, 75% of the collected solar energy would be used. This amount would supply approximately 50% of the building cooling load. (Author)

A77-38300 # **The M-14P aircraft engine (Aviatsionnyi dvigatel' M-14P).** A. M. Lapshin and P. I. Anokhin. Moscow, Izdatel'stvo Transport, 1976. 230 p. In Russian.

The M-14P aircraft engine is a low-power, air-cooled four-stroke gasoline engine, the nine cylinders of which are in star configuration, designed for service on the multipurpose four-seater Yak-18T and the Yak-50 sport plane. This book gives a technical description of all the main parts of the engine. Operation of the various subsystems is described. Attention is given to the cylinder-piston group, the connecting rods, the crank, the reductor, the gear box, the drive mechanisms, the supercharger, the gas distribution system, the lubrication and cooling systems, the fuel pump and filter and the carburator, ignition and start-up system, and the air fan. Information on servicing and upkeep of the engine is also provided. P.T.H.

A77-38330 Photoelectronic properties of CdTe-electrolyte heterojunctions - Feasibility as solar energy converters. C. Menezes, F. Sánchez-Sinencio, J. S. Helman (Instituto Politécnico Nacional, Mexico City, Mexico), R. Williams, and J. Dresner (RCA Laboratories, Princeton, N.J.). *Applied Physics Letters,* vol. 31, July 1, 1977, p. 16-18. 15 refs. *Research supported by the Consejo Nacional* de Ciencia y Tecnologia, Research Corp., and NSF.

Cadmium telluride is shown to be a promising material for semiconductor-electrolyte solar cells. Polycrystalline n-type CdTe, in contact with an aqueous solution of SnCl2, forms a well-defined Schottky barrier. The efficiency in sunlight is 4.8 per cent. The cell shows a drift of characteristics with time that may be associated with a low rate of formation of hydroxide on the surface. However, operating stability is relatively good compared with other semiconductor-electrolyte cells that have been reported in the past. (Author)

A77-38367 Solar conversion efficiency of pressure sintered cadmium selenide liquid junction cells. B. Miller, A. Heller, M. Robbins, S. Menezes, K. C. Chang, and J. Thomson, Jr. (Bell Telephone Laboratories, Inc., Murray Hill, N.J.). *Electrochemical Society, Journal,* vol. 124, July 1977, p. 1019-1021. 22 refs.

Pressure sintered electrodes of cadmium selenide subsequently doped with cadmium vapor have shown solar energy conversion efficiencies approaching three-fourths of those of single crystal specimens in sunlight experiments. The cell CdSe/1F Na2S-1F S-1F NaOH/C has operated at 5.1% conversion efficiency under AM2 conditions with polycrystalline electrodes. The relatively small sacrifice of efficiency from single crystal values of 7.5 plus or minus 0.5% suggests the possibility of substantial cost advantage. The temperature and pressure conditions, cadmium doping procedure, material characterization, and voltammetric behavior of the cell are discussed. (Author)

A77-38373 # **Optimization of automotive engine fuel economy and emissions.** R. Prabhakar, S. J. Citron, and R. E. Goodson (Purdue University, Lafayette, Ind.). *ASME, Transactions, Series G - Journal of Dynamic Systems, Measurement, and Control,* vol. 99, June 1977, p. 109-117. 44 refs. Navy-supported research.

Curve fitting techniques are used to analytically represent experimental data on engine emissions as a function of engine operating variables. A model of the engine-vehicle system is formulated and the optimal control inputs for a given vehicle and specified test cycle are computed. Air-fuel ratio, spark advance, and exhaust gas recirculation are considered as the control variables. The results of the study indicate that considerable improvement over stock car performance can be obtained if the control variables are varied in an optimal manner over the driving cycle. (Author)

A77-38446 Sea water - The energy elixir. M. D. Zimmerman. *Machine Design,* vol. 49, July 7, 1977, p. 20-22, 24-26.

Approaches for utilizing the energy stored in the oceans are considered. One approach is based on the utilization of the difference between the temperature of the water at the ocean surface and the temperature of deep-ocean waters. The approach is to employ a working fluid that boils and condenses at small temperature differences, like ammonia, to establish a closed power-conversion cycle. Other approaches considered are to make use of the moon-driven tides, the power of wind-swept waves, or the energy which can be released from the mixing of freshwater with saltwater. Attention is also given to a number of unresolved issues concerning ocean-energy systems. G.R.

A77-38461 # **Power supplies for full time fly-by-wire aircraft control systems.** G. Belcher and P. Chapman (Marconi-Elliott Avionic Systems, Ltd., Rochester, Kent, England). In: Symposium on Avionics versus Electrics - Who Should Determine Future Power Supplies, London, England, March 15, 1977, Proceedings. (A77-38458 17-07) London, Royal Aeronautical Society, 1977. 19 p.

System requirements in the case of a fly-by-wire system without mechanical reversion are examined. In the ideal system the power supplies for each lane of control are completely isolated. This leads to a large number of generators, transformer rectifier units, and batteries. However, the required degree of isolation can also be obtained by the provision of buffering between the primary sources of power and the multiple lanes. Attention is given to the consolidation of supplies, problems related to transients, power system configurations, and equipment design features. G.R.

A77-38477 # **Space applications for terrestrial resources.** B. O'Leary (Princeton University, Princeton, N.J.). *AIAA Student Journal,* vol. 15, Summer 1977, p. 14-17. 6 refs.

A case is made for the allocation of funds to develop a concept (O'Neill, 1974) for the use of non-terrestrial materials in the construction of satellite solar power stations. It is argued that such a project could be undertaken within the next 10 to 20 years within the constraints of the current annual budget of NASA. With the Space Shuttle coming into service in the 1980s, the concept would require no major new technology. Economic analyses suggest a favorable cost-benefit ratio for delivered electricity at a lower environmental cost than exploitation of coal and nuclear power. C.K.D.

A77-38497 Development of cumulative noise measure for the prediction of general annoyance in an average population. C. G. Rice (Southampton, University, Southampton, England). *Journal of Sound and Vibration,* vol. 52, June 8, 1977, p. 345-364. 11 refs.

A laboratory method, previously developed to allow subjects to listen to and make subjective reactions to complex exposures of aircraft noise, was modified to permit study of the annoyance from both aircraft and traffic noise heard over periods of time. No single unifying index was found suitable for use with combinations of the two noises, but the best common measure for use with either aircraft or traffic noise seems to be L(eq), the equivalent continuous sound level. No measure appeared significantly better than NEF (noise exposure forecast) or L(10)(dB(A)) for aircraft noise alone or traffic noise alone, respectively. It is recommended that separate indices be retained for the two noise sources. M.L.

A77-38526 OPTIMO - A method for process evaluation applied to the thermochemical decomposition of water. A. Broggi, R. Joels, M. Morbello, and B. Spelta (EURATOM and Comitato Nazionale per l'Energia Nucleare, Centro Comune di Ricerche, Ispra, Italy). *International Journal of Hydrogen Energy,* vol. 2, Mar. 25, 1977, p. 23-30.

One of the main activities of the J.R.C. research programme to develop processes for hydrogen production, is the process evaluation of potential hydrogen producing methods. This paper describes the computer code OPTIMO, which was conceived as a tool to be used for the development and analysis of various cycles. The code relies on as a base, the synthesis of a flowsheet for each process. Mass and energy balances are then computed, followed by an automatic synthesis of a heat exchange network which is worked out with the idea of maximizing firstly the heat recovered within the process and secondly, the quality of the rejected heat which is available for electricity production. Finally, the process efficiency and an estimate of the investment cost are calculated. (Author)

A77-38527 **Large scale hydrogen production utilizing carbon in renewable resources.** C. A. Rohrmann and J. Greenborg (Battelle Pacific Northwest Laboratories, Richland, Wash.). *(Energy Research and Development Administration and University of Miami, World Hydrogen Energy Conference, 1st, Miami Beach, Fla., Mar. 13, 1976.) International Journal of Hydrogen Energy*, vol. 2, Mar. 25, 1977, p. 31-40. 10 refs. Contract No. AT(45-1)-1830.

By the year 2000 the hydrogen requirements could be met using about one third of available residues. The large and increasing amounts of wastes and residues from agriculture, forestry, other industrial and municipal activities are viewed as renewable resources to provide large amounts of hydrogen. In carbon content the current magnitude of such residues exceeds that in the current annual production of all of the coal mined in the U.S. The hydrogen would be produced from these residues by pyrolysis-gasification processes followed by completing the reaction between water and carbon monoxide. The resulting mixture is principally hydrogen together with carbon dioxide and water vapor which are readily separated to yield nearly pure hydrogen. A net yield of one pound of hydrogen per five pounds of carbon in the residue is anticipated. Environmental concerns, intensified agriculture and the development of more effective residue collection and delivery systems assure that residues will be more economical than the conventional carbon resources. The demand for hydrogen has been projected to the years 2000 and 2020 at 14 and 50 quads respectively. (Author)

A77-38528 **Thermolysis or electrolysis - Why we choose the latter.** R. A. Bidard (Compagnie Electro-Mécanique, Paris, France). *International Journal of Hydrogen Energy*, vol. 2, Mar. 25, 1977, p. 61-68.

The author compares thermolysis and electrolysis of water in terms of energy conservation and investments. As for the first term he emphasizes that, for perfect reversible models, the result should be the same. As for the second term, on the other hand, he shows that, for thermolysis, such result would imply important investments in mechanical machines. This is the consequence of the fact that in such chemical processes, it is not possible to avoid the rejection of high temperature heat unless one provides a sort of heat pump effect thanks to mechanical machines. Actual chemical practice being very far from such sophistication, the author concludes that competitive electrolysis is easier to attain. (Author)

A77-38529 * **Thermochemical hydrogen production via a cycle using barium and sulfur - Reaction between barium sulfide and water.** K. Ota and W. L. Conger (Kentucky, University, Lexington, Ky.). *International Journal of Hydrogen Energy*, vol. 2, June 2, 1977, p. 101-106. 9 refs. Grant No. NGR-18-001-086; Contract No. E(40-1)-5129.

The reaction between barium sulfide and water, a reaction found in several sulfur based thermochemical cycles, was investigated kinetically at 653-866 C. Gaseous products were hydrogen and hydrogen sulfide. The rate determining step for hydrogen formation was a surface reaction between barium sulfide and water. An expression was derived for the rate of hydrogen formation. (Author)

A77-38530 **Theoretical treatment of the photoelectrochemical production of hydrogen.** J. O. Bockris and K. Uosaki (South Australia, Flinders University, Bedford Park, Australia). *International Journal of Hydrogen Energy*, vol. 2, June 2, 1977, p. 123-138. 26 refs.

Theoretical expressions for photocurrents at p-type and n-type semiconductors have been set up under the initial assumption that the rate determining step is the discharge process for H3O(+) at p-type electrode and OH(-) (or H2O) at n-type electrode. The photocurrents at individual electrodes are calculated using the characteristics of semiconductor electrodes, e.g. energy gap etc. The calculated results for the quantum efficiencies are from .01 to 10% depending on the properties of the semiconductors (c.f. a maximum of 0.1% in the metal case). The theoretical results for TiO2 are inconsistent with observations. Consequently, the presence of surface states and the supply of holes as the rate determining step are introduced into the model's formalism and yield results consistent with observation. The photocurrents or whole cells are calculated, and finally the hydrogen production rate under solar irradiation is evaluated for a typical cell. (Author)

A77-38531 **Heat and mass transfer analysis of Bacon-type hydrogen-oxygen fuel cells - The volume average velocity.** Y. Bayazitoglu (Houston, University, Houston, Tex.) and G. E. Smith (Michigan, University, Ann Arbor, Mich.). *International Journal of Hydrogen Energy*, vol. 2, June 2, 1977, p. 139-153. 14 refs.

A model is developed to study the transient electrolyte water evaporation and heat rejection in an operating fuel cell. The model applies to fuel cells which circulate reactant gas in excess of that consumed in the electrochemical reaction to remove the product water as well as heat. The model mass transfer equations are expressed in terms of volume average velocity. It has been shown that the mathematical representation of the volume average velocity model is attractive for computational purposes, since the volumetric disappearance of electrolyte volume for a fixed control volume in space would yield a change in concentration as would actually occur due to dilution. Because of the non-linearities associated with the developed model equations, the finite-difference technique is used to obtain solutions. The implicit finite-difference scheme was selected so as to avoid the stability criteria associated with the explicit form, which places an undesirable restriction on the size of the time increment that can be used. After its accuracy had been established, the method was used to study an operating Bacon-type hydrogen-oxygen fuel cell. (Author)

A77-38532 **Synthetic carbonaceous fuel and feedstock using nuclear power, air and water.** M. Steinberg (Brookhaven National Laboratory, Upton, N.Y.) and S. Baron (Burns and Roe, Inc., Oradell, N.J.). *International Journal of Hydrogen Energy*, vol. 2, June 2, 1977, p. 189-207. 13 refs.

A number of methods for the recovery of CO2 from the atmosphere or oceans for use in the production of synthetic carbonaceous fuels and feedstocks are examined. These include an absorption-stripping system utilizing dilute carbonate solvent, distillation, and an isothermal process using chlor-alkali cells. The synthesis of carbonaceous fuel by catalytic recombination of CO2 and H2 is discussed. An economic analysis of systems producing methane and methanol using off-peak nuclear power is presented. C.K.D.

A77-38533 **Aviation transportation and atmospheric pollution (Le transport aérien et la pollution atmosphérique).** M. Pianko (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *L'Aéronautique et l'Astronautique*, no. 64, 1977, p. 3-8. In French.

The contribution of aviation to pollution of the atmosphere is examined and compared to pollution from other comparable sources (burning hydrocarbons). Phases of air flight producing greater amounts of pollutants (takeoff and climb) are compared to lesser-pollution phases (cruise, approach and landing). Ground-level pollution in taxiing is considered. Aviation sources are found far less polluting than other hydrocarbon-burning sources, on an overall basis; jet aircraft engines contribute less pollution than aircraft piston engines do. Effects of specific pollutants (nitrogen oxides, hydrocarbons, carbon soot and smoke) are assessed. Measures for further reduction of aircraft-generated pollutants are discussed briefly. R.D.V.

A77-38575 # **Evaluation of propulsive lift enhancement and variable cycle engines for advanced tactical aircraft.** A. W. Martin (Rockwell International Corp., Aircraft Div., Los Angeles, Calif.). *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Conference, 13th, Orlando, Fla., July 11-13, 1977, AIAA Paper 77-885.* 10 p. 9 refs.

An advanced tactical fighter study has been conducted to determine (1) the benefits obtainable with propulsive lift enhancement for aircraft having fixed cycle engines, (2) the benefits obtainable with variable cycle engines for aircraft having propulsive

lift enhancement, and (3) the desired characteristics of variable cycle engines. Study results are presented which show that both propulsive lift enhancement and variable cycle engines can provide significant improvements in performance for an aircraft of given size, or a reduction in aircraft size, and lifetime fuel consumption for a given performance level. (Author)

A77-38673 Fuels from biomass - Energy outlay versus energy returns: A critical appraisal. C. W. Lewis (Strathclyde, University, Glasgow, Scotland). *Energy* (UK), vol. 2, Sept. 1977, p. 241-248. 35 refs.

The concept of fuel production by the microbial conversion of biomass is discussed with particular emphasis upon the energy implications involved. Both the energy requirements and energy returns for a number of selected systems are assessed in the light of current technology, while areas for future improvements are also mentioned. The general trend of such biological energy systems is that energy gains made via plant photosynthesis using intensive systems are subsequently more than lost in the conversion of biomass energy content into storable, high-energy fuels such as ethanol and methane. Of the operations under investigation, the growth of *sugarcane and its fermentation to ethanol is considered to be the* most favorable as a marginal net energy production process. (Author)

A77-38674 Can we control the carbon dioxide in the atmosphere. F. J. Dyson (Institute for Energy Analysis, Oak Ridge, Tenn.). *Energy* (UK), vol. 2, Sept. 1977, p. 287-291. 21 refs.

The carbon dioxide generated by burning fossil fuels can theoretically be controlled by growing trees. Quantitative estimates are made of the size and cost of a plant-growing program designed to halt the increase of carbon dioxide in the atmosphere. (Author)

A77-38675 Accounting methods for new-technology non-utility energy installations. A. J. Appleby (CNRS, Laboratoire d'Electrolyse, Meudon, Hauts-de-Seine, France). *Energy* (UK), vol. 2, Sept. 1977, p. 317-319.

Inflation of energy costs, until 1973 an unimportant factor in determining the overall rate of inflation in the economy, promises to become a major influence in determining future price increases as society moves towards the use of nonfossil and synthetic fuels. Since the conventional interest rate is effectively indexed to inflation, and since the energy costs in question are strongly capital-intensive, a snowball effect seems inevitable. A mortage-repayment formula is suggested that has obvious importance when used in an inflationary environment, since it reduces the initial impact of new-technology energy costs compared with formulas used in conventional accounting. In addition, it is advantageous for technologies requiring longer write-off times, and may be particularly useful for small non-utility (e.g., solar) energy installations. (Author)

A77-38786 Approaches to extracting potentially recoverable hydrocarbons. J. J. Stosur (ERDA, Office of Oil and Gas, Washington, D.C.). *International Journal of Energy Research,* vol. 1, Apr.-June 1977, p. 99-114. 26 refs.

The current status of nuclear-explosive fracturing to improve gas production from tight formations and in situ combustion to enhance oil recovery from existing reservoirs are assessed. The current status of projects Gasbuggy, Rulison and Rio Blanco are presented, and it is pointed out that production predictions were considerably overestimated. Several hypotheses to account for this are presented, but the most important seems to be overestimated formation permeability. The limitations of the current technology are discussed, and the greatest obstacle to progress is recognised as public nonacceptability of the technique. The basic processes of in situ combustion for enhanced oil recovery are presented together with a comparison of the recovery efficiency with those of other processes. It is shown that the method offers the highest percentage of oil recovery in heavy oil prospects of any thermal recovery methods proposed so far. However, the method is expensive and highly complex, but it is likely that it is the most widely applicable and that important improvements will be made in the next decade. (Author)

A77-38788 On the energy pattern factor in wind measurements. T. R. Buick, M. A. Doherty, J. T. McMullan, R. Morgan, and R. B. Murray (Ulster, New University, Coleraine, Northern Ireland). *International Journal of Energy Research,* vol. 1, Apr.-June 1977, p. 127-133.

Measurements of the energy pattern factor K sub e were made using a continuous analog technique, rather than by the more usual sampling procedure. The values obtained were significantly larger than the usually accepted figure. The discrepancy is attributed partly to the method of measurement, and partly to the use of rather more typical wind speeds. (Author)

A77-38789 On the optimum orientation of solar collectors. T. Hughes, J. T. McMullan, R. Morgan, and R. B. Murray (Ulster, New University, Coleraine, Northern Ireland). *International Journal of Energy Research,* vol. 1, Apr.-June 1977, p. 143-156. 8 refs.

A simple model of atmospheric absorption and scattering, incorporating only three parameters, has been used to fit meteorological data for direct and diffuse radiation and hours of sunshine at latitude 55 deg N, longitude 6 deg W. Using this fit for insolation on a horizontal plane, annual and monthly figures for insolation on an inclined plane have been computed. It is found that the annual insolation is relatively insensitive to orientation for angles of tilt between zero and 60 deg, but that the optimum tilt is 30.5 deg. When ground reflection is included, the optimum tilt angle rises steadily to 65 deg as the ground albedo increases from zero to unity. Optimization for summer and winter operation is also considered, as is the effect of various characteristics of practical collectors. (Author)

A77-38790 A review of gasification for power generation. B. Robson (Coal Research Establishment, Cheltenham, Glos., England). *International Journal of Energy Research,* vol. 1, Apr.-June 1977, p. 157-177. 27 refs.

The paper is a review of the state of the art of gasification of coal for power generation. The major part of the review is a description, under the headings of fixed-bed gasification, fluidized-bed gasification, entrained gasification and molten-bath gasification, of the work currently in progress. The only large-scale operational plant is the Steag plant at Lünen in the Federal Republic of Germany, which is based on Lurgi fixed-bed technology. Another large-scale plant which seems certain to be built is the Commonwealth Edison plant at Pekin, and this too is to use Lurgi gasifiers. *All other work is still in the development stage and unlikely to reach* commercial scale for several years. Hopefully, this will roughly coincide with the time when gas turbines can withstand inlet temperatures of 1200 C or higher. The review briefly describes the current conventional methods of power generation, outlines the three basic types of combined cycle, and then explains why the juncture of gasification and a combined cycle is attractive. This is followed by a section on the quality of gas required for firing gas turbines, and a short outline of equipment available for gasification of coal. (Author)

A77-38792 * The next 25 years: Industrialization of space - Rationale for planning. J. von Puttkamer (NASA, Office of Space Flight, Washington, D.C.). *British Interplanetary Society, Journal (Space Technology),* vol. 30, July 1977, p. 257-264. 15 refs.

A methodology for planning the industralization of space is discussed. The suggested approach combines the extrapolative ('push') approach, in which alternative futures are projected on the basis of past and current trends and tendencies, with the normative ('pull') view, in which an ideal state in the far future is postulated and policies and decisions are directed toward its attainment. *Time-reversed vectors of the future are tied to extrapolated,* trend-oriented vectors of the quasi-present to identify common plateaus or stepping stones in technological development. Important

steps in the industrialization of space to attain the short-range goals of production of space-derived energy, goods and services and the long-range goal of space colonization are discussed. C.K.D.

A77-38825 # **Materials consideration for the Bigas coal gasification pilot plant.** V. L. Brant and L. L. Sluzalis (Stearns-Roger, Inc., Denver, Colo.). *(American Society of Mechanical Engineers, Conference on Petroleum Mechanical Engineering and Pressure Vessels and Piping, Mexico City, Mexico, Sept. 19-24, 1976, Paper 76-PVP-41.) ASME, Transactions, Series J - Journal of Pressure Vessel Technology,* vol. 99, May 1977, p. 322-327. 7 refs.

The Bigas process uses a two stage, superpressure, oxygen-blown slagging gasifier for producing a raw gas from coal which is converted to high BTU pipeline gas. Materials selection and material degradation problems are discussed (and presented in a tabular form) with reference to the different process systems of coal preparation, slurry drying, the gasifier, raw gas cleanup, CO shift, primary methanation, and secondary methanation. B.J.

A77-38837 # **Whirl stability of the pendulously supported flywheel system.** W. T. Thomson (California, University, Santa Barbara, Calif.), F. C. Younger, and H. S. Gordon (William M. Brobeck and Associates, Berkeley, Calif.). *(American Society of Mechanical Engineers, Applied Mechanics/Bioengineering/Fluids Engineering Summer Conference, Yale University, New Haven, Conn., June 15-17, 1977, Paper 77-APM-20.) ASME, Transactions, Series E - Journal of Applied Mechanics,* vol. 44, June 1977, p. 322-328. 7 refs. Research sponsored by the William M. Brobeck and Associates and Electrical Power Research Institute.

The steady-state whirl-spin relationships for the pendulously supported flywheel with bearing flexibilities, stiff sections of shaft and gyroscopic action are derived and experimentally verified. Stable and unstable operations of the system are experimentally demonstrated, and damping necessary to stabilize an inherently unstable system is theoretically derived for two modes of bearing displacements. (Author)

A77-39106 Producer gas from agricultural wastes - Its production and utilization in a converted oil-fired boiler. I. E. Cruz (University of the Philippines, Quezon City, Philippines). *Resource Recovery and Conservation,* vol. 2, May 1977, p. 241-256. 6 refs. Research supported by the National Science Development Board of the Philippines.

A study was made on the performance of a fixed bed gas producer, using agricultural wastes as fuel and air as gasifying medium, and operated either as an up-draft or a down-draft reactor to supply producer gas to a converted oil-fired boiler. Up-draft operation, although achieving better thermal efficiencies, led to serious ash clinkering problems. Down-draft operation solved the problem of clinker formation on the grate at the expense, however, of slightly lower thermal efficiencies and reduced gasification rates. (Author)

A77-39107 Packed bed digestion of solid wastes. D. C. Augenstein, D. L. Wise (Dynatech R & D Co., Cambridge, Mass.), and C. L. Cooney (MIT, Cambridge, Mass.). *Resource Recovery and Conservation,* vol. 2, May 1977, p. 257-262. 9 refs. Research supported by the Consolidated Natural Gas Service Co.

The production of methane by digestion of solid substrates (shredded newspaper of prepared municipal solid waste) in the form of a packed bed was investigated. A digester was filled with solid substrate leaving a small head space. Aqueous nutrients and microorganisms were added in the form of sewage sludge in quantities sufficient to saturate the substrate and fill the headspace. When digestion was completed, the undigested substrate was partly dewatered and removed, fresh substrate was added, and the cycle repeated. It was found that maximum methane yields were obtained by buffering the mixture to pH 5.8 to 8.0; operation at pH 4.3 to 5.0 was found to favor the production of organic acids. The performance of a hypothetical full-scale methane generating facility was assessed using methane yields obtained with the experimental systems. Results indicate that the solid bed process is potentially less costly than conventional digestion technology, with a projected cost per cubic meter of methane of $0.05. C.K.D.

A77-39109 The rate of mass transfer in a solar regenerator. P. Gandhidasan, V. Sriramulu, and M. C. Gupta (Indian Institute of Technology, Madras, India). *Letters in Heat and Mass Transfer,* vol. 4, May-June 1977, p. 185-192. 8 refs.

A study of the effect of a moving liquid film and an air stream on gas-phase controlled convective heat and mass transfer has been made, which would find widespread application in devices which utilize solar energy. The governing equations for air phase have been solved for various values of the ratio of liquid to air velocity. Profiles of velocity, temperature, and concentration as well as their gradients are presented. The results, compared with experimental findings obtained with mass transfer being extended to the liquid phase as well, show an encouraging trend. (Author)

A77-39119 The physics of magnetic separation. M. R. Parker (Salford, University, Salford, Lancs., England). *Contemporary Physics,* vol. 18, May 1977, p. 279-306. 31 refs.

Current activity in the field of magnetic separation is reviewed in fundamental terms. The diverse subject matter is ordered into four main groupings whose characteristics are described in terms of numerous devices, both of present-day and historical significance. Existing as well as potential areas of scientific and commercial operation are discussed. The basic principles of recent major developments in high intensity magnetic separation are closely examined. (Author)

A77-39125 A small but important contribution to the German-American solar research programme 'Helios'. J. Ackermann. *Ball and Roller Bearing Engineering,* vol. 15, no. 2, 1976, p. 41-44.

Azimuth bearings and elevation bearings of the antenna support system (flangeless antenna runwheels transmitting load via cylindrical or spherical roller bearings to the support structure) of the German-American 'Helios' solar research antenna are described. The parabolic radiotelescope antenna and its support structures are described, with special attention given to bearing sleeves and loads. R.D.V.

A77-39270 # **Influence of atmospheric conditions on the parameters of a turbojet engine (Wplyw warunkow atmosferycznych na parametry silnika turboodrzutowego).** J. Borgon and M. Mokrzyszczak. *Technika Lotnicza i Astronautyczna,* vol. 32, Mar. 1977, p. 15, 16. In Polish.

Thermodynamic and gasdynamic calculations for turbojet engines are conventionally carried out for a standard atmosphere. In practice, however, changes in atmospheric pressure result in proportional changes in flow-area pressure, producing changes in engine trust, fuel consumption, and rate of airflow (all other parameters remaining constant). The results of in-flight tests carried out with 'Lis' turbojet engines, showing the behavior of these three parameters under various atmospheric conditions are diagrammed and discussed. V.P.

A77-39314 Flywheel energy storage. I - Basic concepts. J. A. Kirk (Maryland, University, College Park, Md.). *International Journal of Mechanical Sciences,* vol. 19, no. 4, 1977, p. 223-231. 26 refs.

The basic concepts of flywheel energy storage systems are described in the first part of a two part paper. General equations for the charging and discharging characteristics of flywheel systems are developed and energy density formulas for flywheel rotors are discussed. It is shown that a suspended pierced disk flywheel is competitive with the super-flywheel designs currently being suggested in the literature. (Author)

A77-39315 * **Flywheel energy storage. II - Magnetically suspended superflywheel.** J. A. Kirk (Maryland, University, College Park, Md.) and P. A. Studer (NASA, Goddard Space Flight Center,

Electromechanical Branch, Greenbelt, Md.). *International Journal of Mechanical Sciences*, vol. 19, no. 4, 1977, p. 233-245. 29 refs.

This article, the second of a two part paper, describes the general design requirements for a flywheel energy storage system. A new superflywheel energy storage system, using a spokeless, magnetically suspended, composite material pierced disk rotor is proposed. The new system is configured around a permanent magnet ('flux biased') magnetic suspension system with active control in the radial direction and passive control in the axial direction. The storage ring is used as a moving rotor and electronic commutation of stationary armature coils is proposed. There is no mechanical contact with the rotating ring and long life and low run down losses are projected. A discussion of major components for a 10 kwh system is presented. (Author)

A77-39467 **Urban transportation technology.** T. McGean. Lexington, Mass., D.C. Heath and Co., 1976. 305 p. 151 refs. $22.50.

Engineering tools for assessing the feasibility and performance of urban transportation hardware and for documenting the performance capabilities of existing hardware concepts are presented. Parametric tradeoff analyses for all types of transit systems are discussed. General topics include headway and capacity relationships, typical performance levels for different transportation systems, station design, and the environmental impact of transportation systems. Chapters on vehicle technology emphasize propulsion and braking systems, ride quality, and steering and switching concepts. C.K.D.

A77-39494 **Solar cell equipment with concentrating mirrors and radiator surfaces (Solarzellenanlage mit konzentrierenden Spiegeln und Radiatorflächen).** D. Rex (Braunschweig, Technische Universität, Braunschweig, West Germany). *Zeitschrift für Flugwissenschaften und Weltraumforschung*, vol. 1, May-June 1977, p. 210-222. 8 refs. In German.

A new design for space solar generators is investigated in which solar radiation is focused on the solar cells by cylinder-parabolic mirrors. The mirrors also act as radiator fins for cooling the solar cells. The interior area of such a panel (except the supporting structure), consisting of an array of radiating mirror fins and solar cells, is analyzed with respect to geometry and thermal behavior, also taking account of its structural stability. Results of the calculation show that by this concept the mass-to-power ratio of the interior area of a solar panel is reduced. Equally the area per power covered with solar cells is reduced to one third, from which advantages in cost can be expected. Constructive design of the entire panel is still to be carried out. (Author)

A77-39499 # **Application of solar energy in Belgium - Study of a flat plate collector (Toepassing van zonneenergie in Belgie - Studie van een vlakke-plaatkollektor).** F. de Schauwer and J. de Smet. Leuven, Katholieke Universiteit, Fakulteit der Toegepaste Wetenschappen, *Burgerlijk Werktuigkundig Ingenieur Dissertation*, 1975. 201 p. 79 refs. In Flemish.

Climatological and technical aspects of using a flat plate collector for conversion of solar energy are studied. A general analysis is given which enables calculation of useful incident solar energy at a given location. Considerations on choice of materials, selective absorbers and filters, for flat plate collectors are discussed. A detailed analysis of losses by various paths in a solar collector is given. An experiment arrangement for heating water for household purposes is described. A mathematical model of the flat plate collector is given. P.T.H.

A77-39504 **Energy conservation in the investment policies of French firms. I - Formulation of the problem (Les économies d'énergie dans la politique d'investissement de l'entreprise française. I - Formulation du problème).** M. Castagne and J.-J. Picard (Lorraine, Institut National Polytechnique, Nancy, France). *Revue de l'Energie*, vol. 28, May 1977, p. 314-318. In French.

An approach to formulating and formalizing the study of energy conservation by industries is indicated. Lack of knowledge about the real costs of energy and money are thought to affect industrial planning. A national policy is suggested for encouraging firms to adopt an optimal position with respect to energy consumption. It is also suggested that factory equipment should be considered from the vantage point of the optimal position. M.L.

A77-39505 **Comparative energy policies of France, England, and Germany. II - Electricity and nuclear energy (Les politiques énergétiques comparées de la France, de l'Angleterre et de l'Allemagne. II - Electricité et énergie nucléaire).** G. de Carmoy (Institut Européen d'Administration d'Affaires, Fontainebleau, Seine-et-Marne; Paris, Institut d'Etudes Politiques, Paris, France). *Revue de l'Energie*, vol. 28, May 1977, p. 319-326. 7 refs. In French.

The achievements and goals of France, England, and Germany with regard to electricity production by nuclear facilities are described. Various reactor types and energy-generating processes are considered, and the nuclear energy policies of the three countries are compared. The implications of these policies are examined with attention to the shortages in supplies of traditional fuels. M.L.

A77-39506 # **Heat mirrored solar energy receivers.** P. O. Jarvinen (MIT, Lexington, Mass.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-728*. 6 p. USAF-sponsored research.

Transparent heat mirrors that transmit in the visible and reflect in the infrared, being developed at the M.I.T. Lincoln Laboratory for solar energy applications, include such film types as metal, semiconductor, composite layer, and thin-film microgrids. The improved performance realized in a windowed, high temperature (1000-3000 F) cavity receiver by heat mirrors are evaluated. Theoretical predictions for an idealized heat mirror cavity show potential operating efficiency improvement of 20 to 30 points depending on incident sun levels and cavity operating temperatures. Existing heat mirrors approach the efficiencies predicted for ideal heat mirrors. (Author)

A77-39507 # **Application of heat pipes to ground storage of solar energy.** E. J. Kroliczek (B & K Engineering, Inc., Towson, Md.), S. W. Yuan, and A. M. Bloom (George Washington University, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-729*. 6 p. 8 refs.

A heat pipe concept design for application to residential solar energy storage has been developed. The basic feasibility of the concept has been demonstrated in prototype testing at George Washington University. The design incorporates the simplicity and high efficiency of the heat pipe together with current heat pipe thermal control techniques and an external pump assist for liquid return against gravity. As configured the heat pipe system provides the capability of transferring heat from solar collectors to an energy storage area and points of utilization within a single heat transfer element. All control functions are inherent in the heat pipe construction including automatic shutdown of the solar collector zone when positive net energy flow is not achieved. Pumping power requirements are minimal and needed only during solar input periods. Future designs could utilize solar energy to drive the pump. Finally, the heat pipe system can be interfaced with any one or combination of household heat transfer mediums including air, hot water or working fluids from air conditioners or heat pumps. This paper describes the concept, the details of a prototype design and the results obtained with a simulated ground storage test system. (Author)

A77-39512 * # **Axially grooved heat pipes - 1976.** P. J. Brennan, E. J. Kroliczek, H. Jen (B & K Engineering, Inc., Towson, Md.), and R. McIntosh (NASA, Goddard Space Flight Center, Greenbelt, Md.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-747*. 10 p. 23 refs.

This paper summarizes the 'state-of-the-art' of axially grooved heat pipes. Applications are identified and the related heat pipe design and performance are defined. Recent developments in the analysis, design and fabrication of axially grooved hardware are also discussed. A mathematical model which predicts the hydrodynamic behavior and accounts for liquid recession, liquid/vapor shear interaction and 1-g puddle flow is also presented. Performance data for various fluids in the 100-500 K range is compared to predictions from the Groove Analysis Program (GAP). Finally, a simplified closed form solution which accounts for gravity effects, self-priming and composite pumping by the grooves as well as all of the hydrodynamic losses is also discussed. (Author)

A77-39514 * # **Development of a low temperature phase change material package.** P. J. Brennan, H. J. Suelau (B & K Engineering, Inc., Towson, Md.), and R. McIntosh (NASA, Goddard Space Flight Center, Greenbelt, Md.). *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 12th, Albuquerque, N. Mex., June 27-29, 1977, Paper 77-762.* 6 p. 5 refs.

Test data obtained for a low temperature phase change material (PCM) canisters are presented. The canister was designed to provide up to 30 w-hrs of storage capacity at approximately -90 C with an overall thermal conductance which is greater than 8 w/deg C. N-heptane which is an n-paraffin and has a -90.6 C freezing point was used as the working fluid. The canister was fabricated from aluminum and has an aluminum honeycomb core. Its void volume permits service temperatures up to 70 C. Results obtained from component and system's tests indicate well defined melting and freezing points which are repeatable and within 1 C of each other. Subcooling effects are less than 0.5 C and are essentially negligible. Measured storage capacities are within 94 to 88% the theoretical. (Author)

A77-39526 Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, University of Pittsburgh, Pittsburgh, Pa., May 16-18, 1977, Proceedings. Symposium sponsored by the University of Pittsburgh. Edited by D. Bienstock (ERDA, Pittsburgh Energy Research Center, Pittsburgh, Pa.). Pittsburgh, Pa., Energy Research and Development Administration, 1977. 389 p. $15. (For individual items see A77-39527 to A77-39578)

Attention is given to combustion gas MHD generators, inert gas MHD generators, and liquid metal MHD generators. MHD materials, MHD diagnostics, electrode and wall phenomena, plasma and flow phenomena, the effects of slag, and auxiliary components of MHD systems are all considered. B.J.

A77-39527 # **Experiment on MHD generator with a large scale superconducting magnet /ETL Mark V/.** Y. Kusaka, T. Masuda, S. Ikeda, and T. Honda (Ministry of International Trade and Industry, Electrotechnical Laboratory, Tokyo, Japan). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. I.1.1-I.1.10. 11 refs.

The final generating experiment in the first phase of Japan's MHD project was carried out in December 1975 using the ETL Mark V MHD generator combined with a superconducting magnet. The channel was of cold-wall type with a Faraday-type segmented electrode. The electrode materials were Cu-W alloy and stainless steel for cathode and anode, respectively. The measuring system as a whole operated successfully and data pertaining to electric, thermal and gasdynamic parameters of the generator were obtained. B.J.

A77-39528 # **Mark VI MHD generator studies.** A. Solbes, S. Petty, I. Sadovnik, and R. Kessler (Avco Everett Research Laboratory, Inc., Everett, Mass.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. I.2.11-I.2.18. 9 refs. ERDA-supported research.

The results of MHD generator studies are presented. These include channel modeling and performance, non-rectangular (V-wall) cross-sections and channel loading and faults. An analytical model aimed at predicting the overall performance of channels is presented. The results of theoretical calculations are compared with experimental measurements. These include electrical conductivity measurements, pressure distribution, current and voltage distribution and overall performance. The salient construction features of a V-wall channel are described. Preliminary performance characteristics are presented. Also presented are the results of loading experiments which include diagonal and Faraday loading, nonuniform local loading and fault simulation studies. (Author)

A77-39529 # **Experimental investigation of multiple-loaded diagonal conducting wall generators.** J. W. Muehlhauser, T. My, M. H. Scott, Y. C. L. Wu, and J. B. Dicks (Tennessee, University, Tullahoma, Tenn.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. I.3.19-I.3.24. 13 refs. Contract No. EX-76-C-01-1760.

Two multiple-loading schemes (two limiting cases) were investigated with a 60 deg-diagonal MHD wall generator. The feedback coupling scheme was found to provide the maximum interaction among the different loading sections. The direct-coupling scheme, on the other hand, is the minimum interacting scheme, with each loading section operating very much like an independent subgenerator. Results are obtained on interelectrode voltage fluctuations, current distribution on collecting electrodes, and fluctuations in electrical parameters. B.J.

A77-39530 # **Gaseous electrode development at RMC.** E. P. Scannell, M. T. Dooley, R. S. Hiers, G. E. Staats, and N. A. Bradley (Reynolds Metals Co., Energy Conversion Div., Sheffield, Ala.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. I.4.25-I.4.30. 7 refs. Contract No. E(49-18)-2476.

This paper describes a program being conducted by the Energy Conversion Division of the Reynolds Metals Company (RMC) for development of a gaseous (plasma) electrode suitable for long-life channel operation in an MHD generator. The basic design consists of a magnetically rotated and translated arc in argon or other inert gas or gas mixture in the annular region between a coaxial cylindrical cathode and anode. The conventional MHD channel solid electrode conducting surface is then replaced by the plasma efflux ionized by the arc and flowing out of a long, thin slot cut parallel to the cylindrical annulus. The RMC-MHD Electrode Development and Generator Test Facilities are described and results are presented of parametric studies of the effects of the variation of gas type and flow rates, magnetic field magnitude, yaw angle to magnetic field, electrode geometry, and electrode materials. (Author)

A77-39531 # **The disk geometry applied to open cycle MHD power generation - Experiments and theoretical considerations.** J. Klepeis and V. Hruby (Avco Everett Research Laboratory, Inc., Everett, Mass.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. I.5.31-I.5.37. 8 refs. ERDA-supported research.

The general purpose of large disk shock tube experiments is to evaluate the performance potential of the disk for a baseload, open-cycle MHD generator. In a new series of radial flow disk experiments, results have been obtained that are encouraging for the disk channel concept. Under plasma conditions that closely simulate that of a coal-fired baseload disk, a maximum output power of 8.33 MW was generated at 4 and 4.5 tesla, corresponding to an enthalpy

extraction of 7% at an isentropic efficiency not less than 50% and an electrical efficiency not less than 55%. B.J.

A77-39532 # Design, construction, and testing of a compact, lightweight combustion driven MHD generator channel and diffuser. O. K. Sonju, D. E. Meader, D. W. Swallom, G. T. Heskey (Maxwell Laboratories, Inc., Woburn, Mass.), R. F. Cooper, J. F. Holt, and D. C. Rabe (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. I.6.38-I.6.42. 5 refs. Contract No. F33615-76-C-2001.

This paper describes the design, construction, and testing of a compact, lightweight combustion driven MHD generator channel and diffuser. The main purpose of this work is to investigate a novel channel design concept using a diagonal wall electrode configuration and a glass-fiber wound composite outer wall structure. A 200 kW MHD channel has been designed and built and is currently being tested. A lightweight diffuser using a thin-walled copper sheet design was also constructed during this program. The results of the development program reported in this paper are part of an overall advancement of the state-of-the-art of compact, lightweight high performance MHD channels and diffusers for transportable burst power MHD generator systems. (Author)

A77-39533 * # Results of closed cycle MHD power generation tests with a helium-cesium working fluid. R. J. Sovie (NASA, Lewis Research Center, Cleveland, Ohio). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. II.1.1-II.1.6. 15 refs.

The cross-sectional dimensions of the MHD channel in the NASA Lewis closed loop facility have been reduced to 3.8 x 11.4 cm. Tests were run in this channel using a helium-cesium working fluid at stagnation pressures of 1.6 x 10 to the 5th N/sq m, stagnation temperatures of 2000-2060 K and an entrance Mach number of 0.36. In these tests Faraday open circuit voltages of 200 V were measured which correspond to a Faraday field of 1750 V/m. Power generation tests were run for different groups of electrode configurations and channel lengths. Hall fields up to 1450 V/m were generated. Power extraction per electrode of 183 W and power densities of 1.7 MW/cu m have been obtained. A total power output of 2 kW was generated for tests with 14 electrodes. The power densities obtained in this channel represent a factor of 3 improvement over those reported for the m = 0.2 channel at the last EAM Symposium. (Author)

A77-39534 # Molecular gas performance of a disk generator with swirl. W. J. Loubsky, J. K. Lytle, J. D. Teare, and J. F. Louis (MIT, Cambridge, Mass.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. II.2.7-II.2.13. 9 refs. Contract No. E(49-18)-2215.

Initial molecular gas performance results in a disk generator with inlet swirl are presented. Plasma properties are analyzed and compared with a chemical kinetics model of the channel flow for test conditions: stagnation temperature = 3400 K, stagnation pressure = 6.6 atm at B = 3.0 tesla for a mixture of 80% N2-20% CO2. The channel flow is characterized by chemical nonequilibrium and low interaction. The measured electron density is consistent with the results of the model, and nearly a factor of seven lower than would be predicted by assuming chemical equilibrium of the carrier gas. Nonuniformities associated with electrothermal plasma turbulence and the presence of wakes lead to a lower Hall coefficient than predicted in the rear portion of the generator. The performance results are encouraging; a peak power density of 20 MW/cu m was achieved for a radial interaction length of only 7.5 cm. Open-circuit values of E-field and Hall coefficient as high as 22 kV/m and 4, respectively, were determined. (Author)

A77-39535 # Experimental fluctuation analysis in a noble gas MHD generator. W. M. Hellebrekers, A. Veefkind, and L. H. Th. Rietjens (Eindhoven, Technische Hogeschool, Eindhoven, Netherlands). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. II.3.14-II.3.21. 5 refs.

This paper describes a series of experiments on fluctuation phenomena in an MHD generator. By measuring the plasma radiation it is possible to determine probability density functions for the electron temperature and electron density. It appears that the relative fluctuation level in T(e) is smaller than in N(e). The average values of conductivity and Hall parameter will be compared with the measured effective values. Due to the fluctuations in the electron density the conductivity is reduced to about 50%. Further, fluctuations in electrode currents have been analyzed. Cross-correlation of these currents gives information about the propagation of the fluctuations along the generator. (Author)

A77-39536 # Argon contamination associated with ceramic regenerative heat exchangers for closed cycle MHD. C. S. Cook and K. M. Dickinson (GE Space Sciences Laboratory, King of Prussia, Pa.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. II.4.22-II.4.30. 11 refs. Contract No. EX-76-C-01-2238.

The characterization of the output argon flow from a ceramic regenerative heat exchanger is presented and found to be suitable for closed cycle MHD power generation. In particular, the 9.5 atma, 2700 F, 5.6 lb/sec argon flow was probed for residual molecular combustion gas and solid particulate contaminants using gas sampling and chromatography, laser light scattering and photometric techniques. Several parametric variations including reheat duration, level of evacuation, fuel and fly ash carryover level were performed and the results are reported. The fundamental conclusions are that molecular gas contaminants can be kept to average total levels of not greater than 100 ppm, and that particulate mass fraction can be kept below 10 to the -6th, levels believed to be below the lower limit for plasma conductivity degradation by suppression of non-equilibrium ionization. Observations were made with respect to matrix slag plugging and refractory durability that are encouraging for direct coal-fired CCMHD. (Author)

A77-39537 # Determination of the non-equilibrium MHD generator optimal parameters in a thermonuclear power station with 'Tokamak' type reactor. M. M. Malikov, V. E. Lukash, R. M. Nurgaliev, M. V. Polikovskii, V. R. Satanovskii, and A. L. Shevchenko (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. II.5.31-II.5.34. 6 refs.

The use of an MHD generator as a way to increase the thermodynamic efficiency of energy conversion of a proposed fusion power plant is investigated for the case of a Tokamak reactor. It is noted that at working fluid temperatures of up to 2100 K, effective MHD generator performance can be obtained only through the use of nonequilibrium plasma ionization. MHD channel flow was treated by one-dimensional analysis with consideration of boundary layer separation criteria. Thermal parameter optimization was carried out using the steepest descent method and the method of conjugate directions with respect to maximum efficiency values. B.J.

A77-39538 # Initial generator tests with revised ambient-temperature liquid-metal MHD facility. G. Fabris, E. S. Pierson, A.

K. Fischer, and C. E. Johnson (Argonne National Laboratory, Argonne, Ill.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. III.1.1-III.1.7. 6 refs. Navy-supported research.

The Argonne National Laboratory ambient-temperature NaK-nitrogen facility was recently rebuilt for tests at higher liquid velocities and pressures. The revised facility is described. Recent runs with the same parameters as with the old facility showed better generator operation was obtained - the slip ratio was lower and the power level was higher. Operation at higher liquid velocities showed still further reductions in slip ratio and increased generator efficiency. The initial steps in a program to evaluate surface-active agents in the generator are described. (Author)

A77-39539 # **Sodium-nitrogen liquid-metal MHD facility initial test results.** E. S. Pierson, P. V. Dauzvardis, and P. F. Dunn (Argonne National Laboratory, Argonne, Ill.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. III.2.8-III.2.13. 12 refs. ERDA-sponsored research.

The Argonne National Laboratory sodium-nitrogen two-phase liquid-metal MHD facility became operational in June 1976. Initial tests at the facility utilized a substitute 'mixer-generator' circular pipe test section. Single- and two-phase pressure-gradient and voltage data were gathered for various operating temperatures and other system parameters. Analysis of the single-phase MHD pressure-gradient data revealed it to be closely correlated with the laminar MHD theory of Chang and Lundgren upon consideration of a sodium-stainless steel contact resistance. A simplified two-phase MHD correlation was developed which best described the two-phase churn-turbulent flow pressure-gradient data obtained. Single-phase voltage profiles were found to be symmetric with respect to the electromagnet pole-face centerline. Two-phase voltage profiles exhibited asymmetries resulting from the expansion of the mixture's gaseous component along the test section length. The influence of operating temperature upon pressure-gradient and voltage data is presented and discussed. (Author)

A77-39540 # **The second joint test of a U.S. electrode system in the U.S.S.R. U-02 facility.** G. Rudins (ERDA, Washington, D.C.), S. J. Schneider, T. Negas (National Bureau of Standards, Washington, D.C.), B. R. Rossing (Westinghouse Research Laboratories, Pittsburgh, Pa.), J. L. Bates (Battelle Pacific Northwest Laboratories, Richland, Wash.), G. P. Telegin, T. I. Borodina, Iu. L. Dolinskii, and V. Zalkind (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. IV.1.1-IV.1.12.

The phase II joint U.S.-U.S.S.R. test of U.S. electrode materials was carried out in Moscow during September 1976 in the Soviet U-02 MHD facility. The test procedure was designed to test five different electrode materials, different lead-out and attachments, and the cathode and anode electrode walls under MHD generator operating conditions. The electrode materials were (in mol%) graded $CeO_2/ZrO_2/Ta_2O_5$, 50CeO2:50ZrO2, 75MgAl2O4:25Fe3O4, 75FeAl2O4:25Fe3O4, and La .95Mg .05CrO3 (LaMg .05Cr .95O3). The electrodes were separately loaded to various assigned current densities during the experiment which lasted a total of 131 hours with 75 hours under MHD power operational conditions. B.J.

A77-39541 # **Corrosion of potential MHD preheater materials in liquid slag and slag-seed.** W. D. Callister, Jr., W. C. Seymour, and V. Griffiths (Montana College of Mineral Science and Technology, Butte, Mont.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. IV.2.13-IV.2.17. Research sponsored by the Montana Energy and MHD Research and Development Institute; Contract No. EF-77-C-01-2524.

The corrosion resistance of potential MHD air preheater refractory ceramic materials was evaluated in rotating rod corrosion tests in molten slag and slag-seed mixtures. Tests were conducted in air on cylindrical, one-half inch diameter specimens which were rotated at 25 rpm, and at temperatures between 1450 deg C and 1650 deg C. Two different compositions of synthetic coal slag containing SiO2, Al2O3, and Fe2O3 were employed. Up to 30 weight percent K2SO4 was added as seed to both slags. Tests on a relatively high purity polycrystalline and fully dense alumina revealed that the slag which contained more CaO and less SiO2 was more corrosive at 1550 deg C, and the amount of corrosion increased by about a factor of five in going from 1550 deg C to 1650 deg C. For both slags, the amount of corrosion first increased and then decreased with increasing K2O content; this may be due to a viscosity change, and/or the formation of a new phase between the alumina and slag-seed constituents. Of several commercially available refractory materials tested in the acidic slag containing 11.9% K2O at 1450 deg C, chrome-spinel and chrome-alumina were the most corrosion resistant, whereas magnesia-alumina spinels were most susceptible to corrosion. (Author)

A77-39542 # **Generator wall slag coating and material corrosion experiments.** L. W. Crawford, C. K. Petersen, J. B. Dicks, and M. S. Beaton (Tennessee, University, Tullahoma, Tenn.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. IV.5.29-IV.5.34. 5 refs. Contract No. EX-76-C-01-1760.

Slag coating of generator walls and material corrosion within the generator are investigated, using a conductivity channel which burns coal with additives (such as K2SO4, calcium, and zircon) and oxygen. To obtain a stable sheath of condensed coal slag on the cooled generator walls, experiments were performed varying the slag mass fraction and the gas velocity, and investigating the properties of acidic and basic coals used. Effects of introducing the additives zircon and calcium were also studied. The addition of calcium gave a thinner slag sheath, increasing corrosion for some materials, while addition of a small amount of zircon gave a thicker sheath, though large amounts produced unstable coatings. Slag penetration into materials tested in the channel was found to be related to the density and chemical purity of the materials. Accelerated corrosion of metals and ceramics in the channel, apparently caused by the large shear stresses present, suggests that material properties of strength and thermal conductivity as well as static corrosion resistance need to be considered in choosing channel materials. J.M.B.

A77-39543 # **Design and performance of high temperature ceramic electrode modules.** H. K. Bowen, R. L. Pober, J. Cordero, M. Yoshimura, J. L. Nash-Webber, J. F. Louis, and W. R. Cannon (MIT, Cambridge, Mass.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. IV.6.35-IV.6-40. ERDA-supported research.

The advantages of super-hot wall electrodes in MHD generators are numerous, but the design, fabrication, and materials of construction have not been established. New materials and new module designs were studied. Electrode modules were tested in a variety of configurations, e.g., singly, in pairs and with or without guard electrodes. Failure of one electrode in a stack affects the performance of the other electrodes. The cool boundary layer from an upstream cold wall can give rise to preferential current paths and arcing. Current fluctuations across the plasma seemed to be directly related to electrode surface conditions, among other reasons. Single and multilayer ceramic electrodes were fabricated. Failures were

principally due to electrochemical effects at interfaces between partial ionic conductors with electronic conductors. Extensive laboratory tests were performed on the compatibility, fluxing and melting points of these materials. (Author)

A77-39544 # **Progress on the testing of refractories for directly-fired MHD air heater service. II.** J. E. Fenstermacher, Jr., L. R. White, and R. R. Smyth (FluiDyne Engineering Corp., Minneapolis, Minn.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. IV.7.41-IV.7.46. Contract No. E(49-18)-2254.

Previous test work on commercially available refractories demonstrated that magnesia-chrome and spinel-bonded magnesia bricks have superior corrosion resistance to the harsh environments that are expected to exist in directly-fired MHD air heaters. However, commercially available magnesia-chrome materials withstand neither the alternating oxidizing-reducing atmospheric conditions nor the thermal fluctuations that will occur in an actual MHD air heater system. Accordingly, the work described here has been focused on developmental refractories that are based on the MgO-Al2O3 system. Simulative corrosion tests on such materials suggested that magnesium aluminate spinel is better suited for MHD air heater use than is magnesia, and subsequent SEM/EDX observations of corroded specimens confirmed this. These results are being used to guide the refractory development program toward improved spinel-based products. (Author)

A77-39545 # **The evaluation of electrode materials for slag coated MHD channels.** L. H. Cadoff, H. D. Smith, and B. R. Rossing (Westinghouse Research and Development Center, Pittsburgh, Pa.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. IV.8.47-IV.8.54. 6 refs. ERDA-supported research.

Static immersion and electrochemical corrosion tests were conducted on three candidate electrode materials in slag-seed mixtures at 1400 C. The flow of direct current was found to alter and accelerate the corrosion reactions that occur in simple immersion tests. In particular, electrolytic reactions at the slag/cathode interface result in corrosion rates an order of magnitude higher than found at the anode. These reactions plus the reducing conditions found at the cathode favor the use of metals or non-oxide ceramics as cathodes while the oxidizing conditions present at the anode favor the use of oxides as anodes. These tests indicate that the selection, testing and use of electrode materials should always be carried out with serious attention to the electrochemical reactions occurring at the electrode/slag interfaces. (Author)

A77-39547 # **Plasma luminosity fluctuations as a diagnostic tool.** M. H. Scott and J. B. Dicks (Tennessee, University, Tullahoma, Tenn.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. V.2.6-V.2.11. 8 refs. Contract No. EX-76-C-01-1760.

The diagnostic utility of the radiation emitted by a combustion plasma is discussed and illustrated in terms of results obtained at the direct coal-fired MHD Facility at the University of Tennessee. The measurement of this parameter allows the determination of relative temperature profiles as well as average propagation velocity. Furthermore, two new concepts concerning the utility of this measurement are introduced. First, the fluctuations of the measured parameter, when examined in terms of frequency content provide a measure of the relative quality of the combustion plasma as related to the presence of non-uniformities that are detrimental to the MHD generator. Secondly, the cross-correlation between two axially separated measurements provides a measure of the velocity fluctuations present in the flow. (Author)

A77-39549 # **Some results of MHD-laser investigation.** L. M. Biberman, V. S. Vorob'ev, R. S. Ivanov, V. T. Karpukhin, N. M. Korolev, A. A. Likalter, M. M. Malikov, A. V. Nedospasov, V. G. Petrov, and G. I. Stotskii (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. V.4.18-V.4.29. 18 refs.

Results are presented for theoretical and experimental investigations of a CO2 laser pumped by a nonequilibrium MHD-generator current. An approximate theory based on laser efficiency is outlined, kinetic calculations describing the process of population inversion are performed, and gains are estimated for an optimum active medium composed of a He-Cs-CO2 mixture. An expression for output power is obtained for the case of constant flow velocity and an optical cavity with its axis parallel to the flow direction. Experimental results are reported for a pulsed He-Cs-CO2 laser pumped via a short-circuited segmented MHD channel of constant cross section. For this laser, the small-signal gain is estimated not to exceed 0.1%/cm, and an effective Hall parameter of about 1 to 1.5 is measured. Results obtained with He-Xe-CO2 and He-Xe-CO2-Ne mixtures are also discussed which indicate that a small addition of CO2 to a He-Xe mixture reduces the apparent Hall parameter to a value of approximately 0.5. F.G.M.

A77-39550 # **Electrical and thermal instabilities in the electrode surface region in a combustion MHD generator channel.** T. Kon, N. Kayukawa, Y. Ozawa, and Y. Aoki (Hokkaido University, Sapporo, Japan). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VI.1.1-VI.1.4. 5 refs.

Theoretical investigations on the electro-thermal instabilities were carried out by means of plane wave and variational analysis for the modeled MHD electrical boundary layer. It was clarified that Hall's effect was one of the most influential parameters on the occurrence of current instabilities. It was also concluded that in order to suppress the instability it was useful to employ an easily ionizable seed material, an electrically resistive, but thermally conductive electrode and/or realize a magnetic field configuration. (Author)

A77-39551 # **Electrical behavior of slag coatings in coal-fired MHD generators.** J. K. Koester and R. M. Nelson (Stanford University, Stanford, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VI.2.5-VI.2.12. 5 refs. Research supported by the Electric Power Research Institute.

The response of slag layers to applied transverse and axial discharges under MHD generator duct conditions was investigated for various metal electrodes and two different coals. Axial slag breakdown and both diffuse and arc mode transverse discharges were observed with cinephotography. The critical current density for diffuse mode operation was an order of magnitude larger for mild steel electrodes than for stainless steel or nickel electrodes. Measured values of slag layer resistance increased rapidly with decreasing electrode temperature. A large contact resistance was measured for the slag layer over the nickel electrode. The excellent slag contact with the steel electrode was traced to chemical interaction of the slag with an iron oxide film on the electrode surface. The large variations in diffuse mode performance for different electrode materials is shown to correlate well with a function of slag layer resistance. (Author)

A77-39552 # **Axial field limitations in MHD generators.** W. Unkel and C. H. Kruger (Stanford University, Stanford, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-

39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VI.4.14-VI.4.20. Contract No. E(49-18)-2341.

Induced and applied field experiments and theoretical calculations have been performed to aid in the understanding of Hall voltage breakdown. Insulator dominated breakdown was observed in the induced field experiments and was qualitatively similar to insulator dominated breakdown observed in the applied field experiments. The breakdown threshold voltage for insulator dominated breakdown was somewhat lower than for the same gap in applied field experiments. Further applied field experiments confirmed the distinction between plasma and insulator dominated breakdown and showed that for plasma breakdown, the insulator eventually becomes the dominant current carrier. This implies that modeling of post-breakdown behavior should concentrate on insulator conduction rather than on plasma conduction. Comparison of theory and experiment for the applied field configuration indicate that the threshold for two-dimensional plasma and insulator thermal runaway can be taken as an upper bound for the experimentally observed plasma and insulator dominated breakdown respectively. (Author)

A77-39553 # **The influence of the transverse current non-uniformity, caused by current leakages onto the insulating walls of the channel, on the local characteristics of a nonideal MHD generator.** V. V. Kirillov (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VI.5.21-VI.5.28. 5 refs.

A77-39554 # **Study of the maximum Hall voltages and interelectrode breakdown in the channel of an open-cycle MHD generator - A joint U.S.-U.S.S.R. experiment on the UO2 facility MHD generator.** D. K. Burenkov, Iu. L. Dolinskii, V. I. Zalkind, V. V. Kirillov, N. N. Strekalov, A. S. Tikolskii, G. L. Uspenskaia (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR), J. F. Louis, D. E. Hastings, and M. Martinez-Sanchez (MIT, Cambridge, Mass.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VI.6.29-VI.6-34.

Complementary experimental and theoretical studies of maximum Hall voltage and interelectrode breakdown were carried out on a generator channel operated in the U-O2 MHD facility using hot electrodes and insulators of surface temperature close to 1900 deg K. The experimental studies included measurements of electrical interelectrode characteristics over a wide range of operation, of plasma electrical characteristics and of surface temperatures. Films were also taken of the interlectrode gap for different levels of electrical stresses. The theoretical studies of interelectrode breakdown considered a Hall voltage recovery of 1.0 representing the ideal case, and a Hall voltage recovery of 0.33 representative of an upper limit case for the conditions achieved in the experiment. (Author)

A77-39555 # **Ohm's law for plasmas with non-isotropic inhomogeneities and its effects on the performance of MHD generators.** S. E. Shamma, M. Martinez-Sanchez, and J. F. Louis (MIT, Cambridge, Mass.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VII.1.1-VII.1.7. 11 refs. Research supported by the University of West Florida; NSF Grant No. MCS-76-18953; Contract No. E(49-18)-2215.

Reduction formulas for the effective, or macroscopic, Ohm's law parameters are derived for inhomogeneous plasmas with anisotropic conductivity fluctuations having two general types of geometry: elongated or shortened in the direction of the magnetic field, two-dimensional, with the direction of constant properties lying in the plane perpendicular to the magnetic field. Two approaches are used, the small perturbation method and an approximate method where each region in the plasma is separately considered, and consistency conditions are used to relate the results corresponding to each separate region to the effective properties of the whole plasma. Both methods are found to agree well when the fluctuations are weak, but differences appear at high fluctuation levels and, for nonuniformities very elongated along the magnetic field, also when the Hall parameter beta is high. Comparison with available exact solutions valid at high beta and strong fluctuation levels indicate that the self-consistency method gives accurate results even in these cases. The results of these analyses are used to evaluate the performance reduction in MHD channels with plasma nonuniformities of several geometries. The power density is reduced most strongly when beta and the r.m.s. of the fluctuations are high, and also when the inhomogeneities are stretched along the magnetic field. (Author)

A77-39556 # **Three dimensional current distribution in diagonal conducting wall channels.** Y. C. L. Wu and G. Rajagopal (Tennessee, University, Tullahoma, Tenn.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VII.2.8-VII.2.12. 15 refs. Contract No. EX-76-C-01-1760.

The three-dimensional electrodynamic problem is solved for the Hall configuration. Representative velocity and temperature profiles for turbulent flow are used in the computation. It can be shown that with a rotation of the coordinate system about z-axis (magnetic field direction), the diagonal conducting wall (DCW) channel are similar to the Hall channel. It is found that the electric potential non-uniformities increase with increasing load under the same gasdynamic conditions. One can introduce a kind of 'electric nonuniformity factor', say delta, in a way similar to the gasdynamic nonuniformity factor (G factor) introduced by Rosa. The electric nonuniformity factor can be used in a simple manner to account for the increase of losses with increasing load. It provides an engineering tool to predict the overall performance of generators. (Author)

A77-39557 # **Coupled electrical and fluid calculations in the cross plane in linear MHD generators.** C. D. Maxwell, D. M. Markham, S. T. Demetriades, and D. A. Oliver (STD Research Corp., Arcadia, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VII.3.13-VII.3.20. 21 refs. Contract No. EX-C-01-2243.

Two dimensional aspects of the coupling between the quasi-three dimensional fluid and electrical equations are presented. It is shown that significant Hall current-induced secondary flows can exist even in Faraday generators. These secondary flows can dominate the turbulence-related secondary flows induced by noncircularity of the duct cross section. Insulator wall velocity overshoots and friction enhancements caused by nonuniform plasma properties are predicted in agreement with previous work. For conducting wall generators, the velocity overshoots can extend over the electrodes as well. The conducting wall generator also exhibits a tendency for current constriction on the sidewall at high values of the Hall parameter. The predicted phenomena are compared to experimental experience with slag deposition patterns and conducting wall sidebar damage. (Author)

A77-39558 # **Calculation of end effects in open-cycle MHD power generators.** J. C. Cutting, C. D. Maxwell, and R. T. Ling (STD Research Corp., Arcadia, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VII.4.21-VII.4.26. 9 refs. Contract No. EF-76-01-2243.

A mathematical model is used to calculate currents and voltage patterns in the end regions of MHD generators of the type now being developed by the Energy Research and Development Administration

(ERDA) for baseload utility service. The model is obtained from a solution of the steady state Maxwell's equation and Ohm's Law. For computation of the resultant partial differential equation, a finite difference computer code employing efficient and storage-conserving numerical methods is adopted. The numerical technique combines the direct solution technique and an iterative process. Several boundary conditions to meet given physical situations are imposed, including assumption of infinitely fine electrode segmentation in the channel. Calculations are performed for three different cases of plasma boundary conditions and magnetic field profiles, and the results indicate significant increases in the asymmetry and strength of electric fields in the downstream end of the generator due to the effects of axial and transverse gradients of the magnetic field. J.M.B.

A77-39559 # **An experimental investigation of fluctuating properties within a combustion MHD generator.** J. P. Barton, J. K. Koester, and M. Mitchner (Stanford University, Stanford, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VII.5.27-VII.5.33. 7 refs. Contract No. E(49-18)-2341.

A highly sensitive (2-20,000 Hz) microphone pressure transducer was used to measure pressure fluctuations in a subsonic, combustion, segmented Faraday generator. Both pressure and voltage probe fluctuations were measured as functions of current density and magnetic field strength for two different mass flow rates. The voltage signals were characterized by convective property variations whereas the pressure signals indicated acoustic oscillations. RMS values, frequency spectra, and cross-correlations for the pressure and voltage fluctuations are presented. At large current-magnetic field interactions, large increases (up to a factor of 4) in pressure fluctuations were observed at low frequencies (less than 100 Hz). (Author)

A77-39560 # **A consideration of some three-dimensional effects in MHD channel.** V. A. Bitiurin, V. N. Zatelepin (Akademiia Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR), and G. A. Liubimov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VII.6.34-VII.6.38. 10 refs.

A study of the occurrence of intensive and essentially three-dimensional secondary flow in linear MHD channels is presented. Such secondary flow may occur as a result of non-potentiality of the body-force. The non-potential component of the Lorentz force may be large enough, for example, under conditions typical of large-scale combustion driven MHD generator with the diagonal-conducting side walls. An analysis of the flow pattern for incompressible fluid case is carried out on the base of some model distributions of the flow parameters in the first order approximation on the MHD interaction number. (Author)

A77-39561 # **Electrode phenomena in slagging MHD channels.** S. Petty, A. Demirjian, and A. Solbes (Avco Everett Research Laboratory, Inc., Everett, Mass.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VIII.1.1-VIII.1.12. 6 refs. ERDA-supported research.

A theoretical and experimental study of electrode phenomena as they relate to the interfacial current transport in slagging MHD channels is presented. An analytical study of the stability of the current transport in the vicinity of electrode walls is given. The critical current density for arcing is shown to depend on the temperature of the plasma or slag-wall interface as well as the unperturbed temperature gradient. Generator studies of the current transport process include voltage drop measurements and visual studies of the current transport to anodes and cathodes. The effect of slag and of the magnetic field are discussed. The wall processes in generators are studied. The degradation characteristics of various anode and cathode materials and designs are evaluated. Long duration MHD channel tests indicate that massive, low temperature metallic current collectors of sufficient thermal diffusivity can operate as cathodes in the arcing regime without any appreciable degradation. Materials of low thermal diffusivity exhibit substantial arc erosion in the absence of slag. Oxidation rather than arc damage is the main degradation process for anode elements. The use of high thermal diffusivity materials appears to minimize the degradation process. (Author)

A77-39562 # **Slag flow and current transport in a simulated generator environment.** D. B. Stickler and R. De Saro (Avco Everett Research Laboratory, Inc., Everett, Mass.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VIII.2.13-VIII.2.20. 12 refs. Research supported by the Electric Power Research Institute.

Steady state and transient slag flow behavior is discussed in terms of a range of system variables. Flow field, combustor stoichiometry, and feed composition were varied in a parametric manner to obtain data on slagging rate and steady state conditions. Results are generally consistent with expectations based on theory. A preliminary test of MHD channel performance dependence on slag composition was also made, with overall results qualitatively consistent with slag properties. (Author)

A77-39563 # **Some properties of coal slags of importance to MHD.** W. Capps (National Bureau of Standards, Washington, D.C.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VIII.3.21-VIII.3.25. 12 refs. Research supported by the U.S. Department of the Interior and ERDA.

Coal slag viscosity, thermal diffusivity, electrical conductivity, vaporization effects and seed-slag interactions are briefly described as they relate to MHD problems. Equations relate viscosity to composition and temperature. K2O from seed causes an increase in viscosity below 30% and a decrease in greater amounts. The maximum is at 15 to 20% K2O. Data on several real slags are given. Slag liquidus temperatures can be inferred from viscosity data. Thermal diffusivity of real and synthetic slags show a minimum at 1000-1100 C. K2O and SiO2 lower diffusivity; Fe2O3 raises it. Vaporization data have been used to predict a stable slag in the channel area with negligible fractionation. Phase equilibria data indicate potassium aluminosilicates will remain stable in K2O-rich vapors but will crystallize in iron-rich slags. This will affect viscosity and conductivity. (Author)

A77-39564 # **Comparison of measurements and predictions of the fluid mechanics and thermal behavior of MHD channel slag layers.** M. E. Rodgers, P. C. Ariessohn, and C. H. Kruger (Stanford University, Stanford, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VIII.4.26-VIII.4.31. 10 refs. Research supported by the Electric Power Research Institute.

Diagnostic methods for measurement of slag layer mass flowrate and thickness are described. Results are reported for experiments in which slag surface thickness, surface temperature and run-off rate are measured. Wall temperature variations of 1000 K are observed to have little effect on slag surface temperature. Preliminary experimental data are consistent with predictions based on a smooth layer flow model for slag. (Author)

A77-39565 # **Electrical conductivity of molten coal slags containing potassium seed.** J. L. Bates (Battelle Pacific Northwest Laboratories, Richland, Wash.). In: Symposium on the Engineering

Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. VIII.5.32-VIII.5.36. Contract No. EV-76-6-06-1830.

This paper summarizes the 600 to 1600 deg C electrical conductivity from a variety of natural molten coal slags containing potassium. The electrical conductivity in air varies depending upon the temperature, original composition, and potassium seed concentration. Below 1400 deg C, the conductivities of different slags can vary by as much as six orders of magnitude. The conductivity increases with increasing temperature, and above 1400 deg C, the conductivities vary by a factor of ten. The conductivities below 1400 deg C can exhibit nonlinear log sigma versus T-1 variations resulting from devitrification and oxidation-reduction. The electrical conductivity increases with increases in potassium and iron content, but decreases with increasing silica content. Slags with high potassium content exhibit high ionic conductivity. The wide variations in electrical conductivity between the different slags and with different potassium content, which coat electrodes and insulators, may be significant in channel performance. (Author)

A77-39566 # **Devolatilization of pulverized coal during rapid heating.** S. K. Ubhayakar, D. B. Stickler, R. E. Gannon, and C. W. von Rosenberg, Jr. (Avco Everett Research Laboratory, Inc., Everett, Mass.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. IX.2.8-IX.2.12. 19 refs. Contract No. E(49-18)-2015.

The concept of utilizing the high volatile yields (about 70%) obtained by the rapid devolatilization of pulverized coal in the exhaust gases of combustion-driven MHD generators is attractive for three reasons. First, the energy of the exhaust gases is stored as chemical energy in the fuel gas product to be used in firing the generator or separately fired air heaters. Second, it minimizes the size and capital costs of the gasification plant, and third, because ashless clean fuel is produced, it minimizes the ash corrosion problems of the refractory air heaters. An experimental and analytical study on the rapid devolatilization of pulverized bituminous coal injected and entrained in hot combustion gases flowing in a constant cross-section gasifier is described. Data on the weight loss through rapid pyrolysis, on the temperature of the heterogeneous medium, and on the composition of the overall products are correlated with an analytical model incorporating two volatile-producing competitive first-order Arrhenius reactions followed by cracking of the volatiles. (Author)

A77-39567 # **Subsonic MHD-diffuser performance with high blockage.** E. D. Doss (Argonne National Laboratory, Argonne, Ill.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. IX.3.13-IX.3.19. 9 refs. Contract No. W-31-109-38.

Diffuser performance with high blockages is analyzed by a two-dimensional turbulent-flow model. This model is used to analyze the performance of simple two-dimensional, plane-walled diffusers and also of three-dimensional diffusers up to and beyond the blockage limits for which previous analytical or experimental data are available. The effects of important design parameters on diffuser performance are investigated. The parameters considered are the blockage, divergence angle, Mach number, aspect ratio, and wall-to-free stream temperature ratio. The first two parameters affect the diffuser performance significantly; the other parameters influence performance only slightly. Results obtained from the subject model agree reasonably well with the available experimental data. The diffuser design of the U-25 facility is analyzed and the analysis predicts a pressure recovery of 0.49, which agrees very well with the measured experimental value of approximately 0.48, obtained from a small-scale model. (Author)

A77-39568 # **Ignition and combustion behavior of pulverized coal jets in hot oxidizing atmospheres.** D. B. Stickler, S. K. Ubhayakar, and F. E. Becker (Avco Everett Research Laboratory, Inc., Everett, Mass.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. IX.4.20-IX.4.27. 9 refs. Contracts No. EF-76-C-01-2015; No. EF-77-C-01-2519.

Measurements of coal ignition and combustion behavior have been made with both vitiation heated air, and the output of a regenerative air heater. In all cases, ignition is hypergolic, with good flame stability. Peak product temperature is in the range 2700-2900 deg K (4400-4760 deg F), at 4 atmospheres pressure, using the regenerative heater system at about 0.30 kg/s (about 0.7 lb/s). It appears feasible to inject coal under these conditions, using a water cooled injector coaxial with low Mach number air injection. Interaction of the combustor with the regenerative air heater system is entirely stable, through ignition and heater cycling. Slag interaction with zirconia combustor liner is found to result in excessive erosion rates for long duration systems, and suggests the desirability of a slagging water cooled wall approach. Ceramic liners do appear useful for short duration research purposes. (Author)

A77-39569 # **Superconducting magnet development for the MHD program.** J. E. C. Williams, D. B. Montgomery, B. A. Apgar, B. M. Bailey, E. S. Bobrov, Y. Iwasa, P. G. Marston (MIT, Cambridge, Mass.), G. Rudins (ERDA, Washington, D.C.), and M. N. Wilson. In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. IX.5.28-IX.5.33. 7 refs. ERDA-supported research.

This paper describes the development of superconducting magnets for the U.S. MHD Program. In particular the areas of technology development are described in terms of work done and of future plans. The objectives of the magnet development program are the construction of superconducting magnets of progressively larger size concurrently with the acquisition of an engineering data base sufficient for their reliable design. (Author)

A77-39570 # **Investigation of factors influencing potassium seed recovery in a direct coal-fired generator system.** K. E. Tempelmeyer, L. Shen, L. Becker, M. Beaton, and J. Martin (Tennessee, University, Tullahoma, Tenn.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. IX.6.34-IX.6.40. Contract No. EX-76-C-01-1760.

Investigation of potassium seed recovery in a direct coal-fired system with high-ash carryover using nominally 3% sulfur Eastern coal has indicated a number of trends. These include: (1) increased temperature level and/or decreased residence times in the flow train increases seed recovery in the form of water soluble K_2SO_4, (2) up to 95% recovery of potassium from fly-ash particles by water washing is possible, (3) recovery of potassium from the large slag pieces that break away from slag layers on the walls of the flow train will be the most difficult problem, (4) weak acid washing of collected slag chunks to recover potassium is much more effective than water washing, and (5) increased turbulence level in a coal-fired system may reduce the seed recovery. (Author)

A77-39571 # **A heat capacitor for MHD electric power generation systems.** T. C. Robles and R. M. Johnson (Montana State University, Bozeman, Mont.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. IX.7.41-IX.7.46.

The control of high temperature air preheater output temperature ripple for a 250 MW thermal input MHD/steam power plant is

considered. It is shown that the introduction of a heat capacitor at the output of the usual regenerative primary heat exchanger array significantly reduces the temperature ripple and somewhat reduces the cost and complexity of the heat exchanger system. (Author)

A77-39572 # **Dynamic modeling and control of magneto-hydrodynamic/steam electrical power generating plants.** J. D. Aspnes (New Hampshire, University, Durham, N.H.) and D. A. Pierre (Montana State University, Bozeman, Mont.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. X.1.1-X.1.7. 12 refs. Research supported by the Montana Energy and MHD Research and Development Institute; Contract No. E(49-19)-1811.

A dynamic power-flow simulation of an overall magneto-hydrodynamic (MHD)/steam electrical power generating plant is developed. Several control configurations are applied to the system, and their effects on system dynamic response are presented. The overall combined-cycle system model utilizes an input-output characterization of the combustor/nozzle/channel/diffuser. This characterization is developed from polynomial approximations of data resulting from the solutions of energy balance, state and continuity equations for the combustor and the quasi one-dimensional MHD equations for the nozzle, channel, and diffuser. The boiler and turbine valve model has turbine valve area and power available to generate steam as inputs, and throttle pressure, power to the turbines, and boiler and stack losses as outputs. Regenerative air preheater cycling is also modeled, and the effect of cycling on plant output is given. (Author)

A77-39573 # **Part-load performance and voltage-current characteristics of a base load MHD generator.** R. J. Rosa (Montana State University, Bozeman, Mont.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. X.2.8-X.2.10.

A knowledge of electrical and aerodynamic response of an MHD generator to load changes is important for the design of the ducting, control system, and inverter of an MHD power plant. It is also of interest to know how the efficiency of a plant will vary with loading. This paper explores the characteristics that are to be expected in a subsonic Faraday generator designed for baseload service. It is shown that a Faraday hookup will tend to act as a constant current source under important conditions. The performance of a subsonic channel in terms of percent enthalpy extraction drops relatively slowly as load is reduced. A ten to fifteen percent drop is predicted at a mass flow rate one-half of the design point value. (Author)

A77-39574 # **Economic and energy considerations in MHD seed regeneration.** P. D. Bergman, D. Gyorke, D. Bienstock (ERDA, Pittsburgh Energy Research Center, Pittsburgh, Pa.), W. Sawko (Pittsburgh, University, Pittsburgh, Pa.), and T. George (U.S. Bureau of Mines, Morgantown, W. Va.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. X.3.11-X.3.23. 26 refs.

An analysis of the energy requirements incurred in the Pittsburgh Energy Research Center scheme for removing sulfur oxides from the combustion products released by a coal-fired 2000 MWt MHD power plant is presented. For a Montana subbituminous C coal containing 1.1 wt% sulfur, a 3.0 wt% sulfur Pittsburgh high-volatile A bituminous coal, and a 4.5 wt% sulfur Illinois no. 6 subbituminous A coal (dry basis), cycle efficiency penalties of 0.2, 1.2, and 2.1 points, respectively, were exacted to achieve SO2 emissions limited to the EPA standard of 1.2 lb SO2 per million Btu for a new coal-fired power plant. If the seed treatment system is not integrated into the MHD power plant, the efficiency penalties quoted above will double in magnitude. These results compare favorably with energy consumption figures for conventional flue gas desulfurization control techniques. A potential credit of 0.1 efficiency points for reducing stack gas exhaust temperatures can partially offset these penalties. Economic results and the influence of key process variables are also explored. (Author)

A77-39575 # **MHD systems with low cooling requirements.** K. D. Annen and R. H. Eustis (Stanford University, Stanford, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. X.4.24-X.4.28. 5 refs. Research supported by the Stanford Institute for Energy Studies.

MHD systems using an air or gas turbine as an intermediate cycle with a small vapor-bottoming cycle are investigated. Both Illinois no. 6 and Montana Rosebud coals, dried to 2% moisture, are used in the study. Thermal efficiencies of greater than 50% were obtained for the systems. Cooling water requirements were obtained which are 30% of those of a conventional steam plant and 60% of those of an MHD-steam plant. The effects of coal type, system configuration, and combustion air preheat temperature on the system performance are discussed. (Author)

A77-39576 # **Coal fired non-equilibrium closed cycle MHD power plant system since ECAS.** C. H. Marston, L. K. Davis, D. A. Rogers, B. Zauderer (General Electric Co., Space Div., Philadelphia, Pa.), J. Bazan (Foster Wheeler Development Corp., John Blizard Research Center, Livingston, N.J.), and J. Parsons (General Electric Co., Schenectady, N.Y.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. X.5.29-X.5.36. 14 refs. ERDA-supported research.

A 1000 MWe Closed Cycle MHD/steam bottoming power plant which incorporates an integrated, two-stage, pressurized, fluidized bed combustor meeting all emission control requirements has been studied. The coal pile to bus bar efficiency for this plant is calculated to be 47%. A DC-DC conversion system is proposed for matching the output of the Faraday MHD Channel to the inverters. The effect on efficiency of perturbations in nominal performance of key components is shown, along with regenerative heat exchanger performance and plant layout. (Author)

A77-39577 # **Status of the reference dual-cycle MHD-steam power plant.** W. D. Jackson (ERDA, Washington, D.C.), R. L. Lawit, R. A. Stoudt, M. G. Klett (Gilbert Associates, Inc., Reading, Pa.), J. C. Cutting, and C. D. Maxwell (STD Research Corp., Arcadia, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. X.6.37-X.6.44. 5 refs. Contract No. EX-76-C-01-2243.

The concepts and goals of a dual cycle commercial size MHD topping-steam bottoming power plant have been translated into a reference design within the limits of present or reasonably projected technology. Trade-offs involving the chosen design characteristics and major parametric evaluations have been performed to select the reference system configuration. This paper defines the system to date, the basis for selection of the subsystems, the viable alternatives and the power plant economics. Many of the factors governing choice of equipment or techniques are not conclusive because of uncertainties which presently exist in design and construction. A parametric analysis of the reference system design was made based upon predicted operating characteristics of the staged coal combustor, the MHD generator-diffuser and the directly-fired air heaters. Equipment has been selected to provide the best compromise between economic and technical aspects. (Author)

A77-39578 # **Open-cycle coal burning MHD power plants for commercial service.** J. C. Cutting, R. F. Schnorr (STD Research Corp., Arcadia, Calif.), R. L. Lawit, B. Headman (Gilbert Associates, Inc., Reading, Pa.), and P. S. Zygielbaum (Electric Power Research Institute, Palo Alto, Calif.). In: Symposium on the Engineering Aspects of Magnetohydrodynamics, 16th, Pittsburgh, Pa., May 16-18, 1977, Proceedings. (A77-39526 18-75) Pittsburgh, Pa., Energy Research and Development Administration, 1977, p. X.7.45-X.7.49. Research supported by the Electric Power Research Institute.

Conceptual design studies regarding four open-cycle MHD power plants have been performed as part of a program concerned with an evaluation of the feasibility of an employment of MHD processes in electric utility power generation. Preliminary results indicate that the 'conventional' MHD plant with a western coal and elemental sulfur recovery represents the most reasonable compromise between performance and cost. G.R.

A77-39585 **Fuel conversion strategy impacts on compliance with photochemical oxidant standards.** S. R. Gautam and H. B. H. Cooper, Jr. (Texas, University, Austin, Tex.). In: Specialty Conference on Ozone/Oxidants - Interaction with the Total Environment, Dallas, Tex., March 10-12, 1976, Proceedings. (A77-39579 18-45) Pittsburgh, Pa., Air Pollution Control Association, 1976, p. 63-76. 12 refs. Research supported by the Federal Energy Administration.

Results of studies assessing the impact on photochemical oxidant concentrations of conversion from natural gas to fuel oil (Los Angeles area) or coal (Houston area). Increased coal consumption in the Houston area may result in elevated sulfate aerosol concentrations. However, due to the high relative humidity in this area and to the presence of calcium carbonate dust, oxidant levels may be reduced as the result of heterogeneous chemical oxidation of sulfur dioxide to sulfates. Increased oil combustion in the South Coast Air Basin of California could produce simultaneous increases in the concentrations of sulfate aerosol and photochemical oxidant levels due to the predominance of photochemical oxidation of sulfur dioxide in the less humid climate. Extensive conversion from gas- to electric-powered vehicles could significantly reduce the levels of photochemical oxidants in Los Angeles, but would have a lesser impact in Houston because of the large industrial base in this city. C.K.D.

A77-39596 **The oxidant formation potential of emissions from catalyst-equipped vehicles.** T. R. Powers (Exxon Research and Engineering Co., Linden, N.J.). In: Specialty Conference on Ozone/Oxidants - Interaction with the Total Environment, Dallas, Tex., March 10-12, 1976, Proceedings. (A77-39579 18-45) Pittsburgh, Pa., Air Pollution Control Association, 1976, p. 189-200. U.S. Environmental Protection Agency Contract No. 68-07-1719.

Treatment of auto exhaust with an oxidation catalyst not only substantially reduces mass emissions of hydrocarbons but also changes the composition of these emissions. In this paper, we report a series of smog chamber studies of the oxidant forming potential of hydrocarbon blends modeled on exhaust emissions from catalyst and non-catalyst vehicles and on the total (exhaust + evaporative + refueling) emissions from a catalyst vehicle. These studies were carried out with 10 hr irradiations and with various degrees of dilution of the chamber during the run. The clear stratification of the blends in terms of oxidant formation indicates that the concept of hydrocarbon reactivity is valid under these simulated 'transport' conditions. Presently available reactivity scales do not fit the data well. However, the scale proposed by Altshuller in 1966 provides a better fit than recently proposed CARB and EPA scales. (Author)

A77-39649 # **The significance of nuclear energy for satisfying future energy requirements (Die Bedeutung der Kernenergie bei der Deckung des künftigen Energiebedarfs).** K. Fuchs (Deutsche Akademie der Wissenschaften, Forschungsbereich Physik, Kern- und Werkstoffwissenschaften, Berlin, East Germany) and G. Schumann (Zittau, Ingenieurhochschule, Zittau, East Germany). *Energietechnik,* vol. 27, May 1977, p. 185-192. 8 refs. In German.

An investigation is conducted concerning the primary energy requirements in the world and the possibilities for satisfying these requirements, taking into account a utilization of uranium. The current data of development of nuclear technology on a global scale is discussed. It is shown that fission nuclear energy can only make a major contribution to the energy balance if a full utilization of the uranium can be obtained with the aid of the fast breeder reactor. A description is presented of the state of development of nuclear energy techniques in the socialist countries, giving attention to the leading position of the USSR with respect to the development of nuclear power stations utilizing fast breeder reactors. G.R.

A77-39650 # **Economic problems concerning the combustion of raw lignite (Wirtschaftliche Probleme der Verbrennung von Rohbraunkohle).** H. Effenberger (Zittau, Ingenieurhochschule, Zittau, East Germany). *Energietechnik,* vol. 27, May 1977, p. 197-200. 8 refs. In German.

Raw lignite constitutes the most important energy carrier in the primary energy balance of the German Democratic Republic. An investigation is conducted concerning the processes which are related to the combustion of lignite in the combustion chamber of modern steam generators, taking into account details of heat transfer, ignition, combustion chamber geometry, wall temperature, combustion intensity, and the calculation of heat transfer by radiation. Attention is also given to questions regarding the efficiency of fuel employment and an operational analysis. G.R.

A77-39655 **Emission and deposition of petrol engine exhaust Pb. I - Deposition of exhaust Pb to plant and soil surfaces.** P. Little and R. D. Wiffen (Atomic Energy Research Establishment, Environmental and Medical Sciences Div., Hardwell, Oxon, England). *Atmospheric Environment,* vol. 11, no. 5, 1977, p. 437-447. 52 refs.

Following the addition of lead-containing anti-knock compounds to gasoline, there has been concern as to the possible harmful effects of increased levels of Pb on the environment. Pb-203 was used in the preparation of radioactively labeled automobile-engine exhaust aerosols. Wind tunnel tests using leaves from 11 species of trees showed that rough or hairy leaf surfaces collected exhaust Pb-203 up to eight times more efficiently than smooth leaf surfaces. The leaf laminas, petioles, and stems of intact shoots of beech, white poplar and nettle showed marked differences in Pb collection efficiencies due to differences in size, shape, and surface texture of the plant parts. B.J.

A77-39657 **Further studies on the oxidation of sulfur dioxide in coal-fired power plant plumes.** J. Forrest and L. Newman (Brookhaven National Laboratory, Upton, N.Y.). *Atmospheric Environment,* vol. 11, no. 5, 1977, p. 465-474. 20 refs. U.S. Environmental Protection Agency Contract No. IAG-D4-0391; Contract No. E(30-1)-16.

The percent of sulfur dioxide converted to sulfate in the plumes of four coal-fired power plants was determined using airborne measurements of particulate sulfur to total sulfur concentration ratios and S-34-S-32 isotope ratios. In general the extent of SO2 oxidation seldom exceeded 5% with essentially all the oxidation occurring within the first few kilometers after emissions. No distinct correlation was found between the extent of SO2 conversion with distance, travel time, temperature, relative humidity, time of day, or atmospheric stability. B.J.

A77-39664 **Answer House story.** J. Smith (Georgia Power Co., Atlanta, Ga.). *(Annual Air Conditioning Conference, 26th, University of Florida, Gainesville, Fla., Feb. 1977.) Building Systems Design,* vol. 74, June-July 1977, p. 39-50.

Design and construction features of four energy research houses in Georgia are described. The heating and cooling requirements and systems are considered, and the solar heating and off-peak storage cooling systems are examined. Monitoring procedures are explained. The houses will be used in a project that gathers and publicizes data

from real houses and families to verify the economic feasibility of various techniques, equipment, and materials. M.L.

A77-39668 # **Ultimate consumption of fuel and energy in the nonindustrial sector (Konecna spotreba paliv a energie v nevyrobni sfere).** L. Rehacek (Vyzkumny Ustav Energeticky, Prague, Czechoslovakia). *Energetika* (Prague), vol. 27, May 1977, p. 208-210. In Czech.

Some tables are presented showing estimated figures for the consumption of energy in the forms of solid fuel, liquid fuel, gas fuel, electricity, and stored heat for nonindustrial uses in Czechoslovakia for the year 1990, and also the projected growth of automobile use through 1990. Attention is called to the need for more efficient energy consumption in the nonindustrial sphere, attainable by better heat insulation of future housing units. P.T.H.

A77-39669 **Wolfersberg - A subterranean storage place for natural gas at a depth of 3000 m (Wolfersberg - Ein unterirdischer Erdgasspeicher in 3000 m Tiefe).** A. Stachel. *Energiewirtschaftliche Tagesfragen,* vol. 27, June 1977, p. 416-421. In German.

The supply of Bavaria, a state of the Federal Republic of Germany, with natural gas requires transportation of the gas over large distances. A pipeline with a capacity which is large enough to transmit gas at peak consumption rates is only partly utilized at times when the gas requirements are lower so it is found to be more economical to employ a pipeline whose capacity corresponds to average consumption rates and to supply additional amounts of gas, when needed, from gas storage facilities. An investigation is conducted regarding the feasibility to use a location of natural gas deposits which are now exhausted as a place for the temporary storage of the gas obtained from the pipeline at times of low gas consumption and a suitable location is found to be at Wolfersberg at a distance of about 20 km from Munich. G.R.

A77-39670 **Natural gas storage in salt caverns (Erdgasspeicherung in Salzkavernen).** W. Harms. *Energiewirtschaftliche Tagesfragen,* vol. 27, June 1977, p. 422-424. In German.

Large differences in natural gas consumption for winter and summer together with irregularities concerning the supply with natural gas make it very important to establish gas reservoirs. It is found that an underground storage of the gas has great economic advantages compared to other types of storage and the feasibility to use in the northern part of Germany salt caverns for the storage of natural gas is investigated. Attention is given to questions regarding the preparation of the caverns, and problems with respect to the operation of natural gas storage facilities in caverns. G.R.

A77-39671 **Transmission solar focusing collector.** F. Demichelis and G. Russo (Torino, Politecnico, Turin, Italy). *Nuovo Cimento, Lettere,* vol. 19, June 4, 1977, p. 145-151.

A solar focusing collector based on total reflection is described which has a concentration ratio of approximately 40 and produces a temperature of about 250 C on the receiver. This collector consists of 'roof'-type prisms so positioned that no prism casts a shadow on any other, the emergent beam does not encounter successive prisms, and the incident radiation is focused stepwise on the receiver. The optical characteristics of the proposed collector are defined, the transmittance of the prisms is discussed, and appropriate materials for the collector are considered. F.G.M.

A77-39673 **The supply of the Federal Republic of Germany and Western Europe with energy, giving particular consideration to the oil and gas potential of the North Sea (Die Energieversorgung der Bundesrepublik Deutschland und Westeuropas unter besonderer Berücksichtigung des Öl- und Gaspotentials der Nordsee).** M. Grathwohl (Bundesministerium der Verteidigung, Führungsakademie, Hamburg, West Germany). *Brennstoff-Wärme-Kraft,* vol. 29, June 1977, p. 233-238. 33 refs. In German.

A77-39674 **Technical and economic aspects of industrial power-heat coupling. I (Technische und wirtschaftliche Aspekte der industriellen Kraft-Wärme-Kopplung. I).** K. H. Maier. *Energie,* vol. 29, May 1977, p. 130-140. 7 refs. In German.

The principle of power-heat coupling provides a possibility for saving fuel. All installations employing power-heat coupling processes are primarily concerned with satisfying the requirements for heat. The production of mechanical energy constitutes in these installations an efficient utilization of thermodynamic possibilities for obtaining a by-product. One of the approaches used involves a generation of steam with a higher pressure and a utilization of the capacity of the steam for doing mechanical work. Attention is given to aspects of the industrial utilization of power-heat coupling processes, questions regarding the economy of electrical power generation for use within the plant itself, the heat consumption in public and industrial electric power generation processes, and an example which illustrates the usefulness of power-heat coupling for the national economy. G.R.

A77-39675 # **Energy recovery by the incineration of solid waste - Development, present status and experiences in Germany.** K. H. Thömen. *Recycling and Waste Disposal,* vol. 2, June 1977, p. 116-120. Abridged.

The development and present status of projects in the Federal Republic of Germany involving the reclamation of heat energy from the combustion of domestic and commercial refuse are discussed. At present, 21 large incinerator plants use the heat content of refuse to produce high grade steam. An additional seven plants produces low-grade steam. The average composition of the refuse used is reported, and combustion systems are described. Mathematical relationships describing the efficiency and design capacity of the plants are given. Alternative applications of heat generated by the incineration of refuse are considered. C.K.D.

A77-39742 **Particle Accelerator Conference: Accelerator Engineering and Technology, Chicago, Ill., March 16-18, 1977, Proceedings.** Conference sponsored by the American Physical Society, National Science Foundation, and Energy Research and Development Administration. Edited by F. T. Cole and R. Donaldson (Fermi National Accelerator Laboratory, Batavia, Ill.). *IEEE Transactions on Nuclear Science,* vol. NS-24, June 1977. 1012 p. (For individual items see A77-39743 to A77-39750)

Attention is given to dc accelerators, linear accelerators, and heavy ion accelerators with special consideration of the fusion applications of accelerators. Beam dynamics, accelerator operations, reliability and targeting and ion sources, meson factories, collective acceleration, intense beams, and storage rings are all discussed. B.J.

A77-39744 **Systems analysis of accelerator and storage ring systems for inertial fusion.** R. Burke, S. Fenster, and S. Grammel (Argonne National Laboratory, Argonne, Ill.). *(APS, NSF, and ERDA, Particle Accelerator Conference: Accelerator Engineering and Technology, Chicago, Ill., Mar. 16-18, 1977.) IEEE Transactions on Nuclear Science,* vol. NS-24, June 1977, p. 996-998.

A computerized systems model is being developed to help assess the relative merits of the various accelerator systems that appear able to meet the requirements for inertial fusion with high energy heavy ion beams. Assessment involves calculating the total cost and parameters that are critical to technical feasibility. Current results showing cost trends and important technical parameters for RF linac/storage ring systems using ions of different mass, charge state, and kinetic energy are presented. (Author)

A77-39747 **Design considerations for a migma advanced fuel fusion reactor.** J. E. Golden, R. A. Miller, B. C. Maglich (Fusion Energy Corp., Princeton, N.J.), S. R. Channon (Fusion Energy Corp., Princeton; Rutgers University, New Brunswick, N.J.), and J. R. Treglio (Fusion Energy Corp., Princeton; Stevens Institute of Technology, Hoboken, N.J.). *(APS, NSF, and ERDA, Particle Accelerator Conference: Accelerator Engineering and Technology,*

Chicago, Ill., Mar. 16-18, 1977.) IEEE Transactions on Nuclear Science, vol. NS-24, June 1977, p. 1018, 1019. 5 refs.

The migma concept requires the injection of ion beams into the field of a superconducting magnet at MeV energies. The features which distinguish this concept from other controlled fusion concepts are high energy, ordered motion, use of advanced fuels, and small physical size. The advanced fuels (other than D-T) such as He-3-He-3 require higher collision energies for useful reaction rates. Power balance in a migmacell is considered. B.J.

A77-39749 Update on the development of 120-keV multi-megawatt neutral beam source. J. M. Haughian, W. R. Baker, L. A. Biagi, D. B. Hopkins, H. M. Owren, and J. A. Paterson (California, University, Berkeley, Calif.). *(APS, NSF, and ERDA, Particle Accelerator Conference: Accelerator Engineering and Technology, Chicago, Ill., Mar. 16-18, 1977.) IEEE Transactions on Nuclear Science,* vol. NS-24, June 1977, p. 1034-1036. 8 refs. ERDA-sponsored research.

The next generation of U.S. fusion experiments, which includes TFTR, MFTF, and Doublet III, will utilize neutral-beam injection for plasma heating. TFTR, for example, desires 20 MW of 120-keV deuterium atoms in pulses of 0.5-sec duration at 5-minute intervals from a total of 12 individual neutral-beam modules. This paper discusses some of the design details of a 15-A, 120-keV, 0.5-sec ion-source module that has recently been built to test design concepts for TFTR sources, and some of the features of the facility where it is presently under test. (Author)

A77-39817 Pacific Northwest geothermal: 1976 review, 1977 outlook. W. Youngquist. *Geothermal Energy,* vol. 5, June 1977, p. 8-13, 15, 16.

Progress made in geothermal exploration and development in the Pacific Northwest during 1976 is reviewed. The status of some of the more important projects in Washington, Idaho, and Oregon is discussed, and institutional barriers to further development of geothermal energy in these states are examined. Advances in the geothermal development program likely to occur during 1977 are outlined. C.K.D.

A77-39818 Geothermal heat - instead of electrically powered compression - proposed for cooling a small residence or office building. E. F. Wehlage. *Geothermal Energy,* vol. 5, June 1977, p. 31-38.

Plans for a proposed demonstration project in the use of geothermal energy for residential air conditioning are discussed. While it does not entirely supplant electric power, the proposed absorption refrigeration system by-passes the greatest single power user in a conventional system - the compressor motor. Flow diagrams are provided for a geothermal cooling system. Factors responsible for the slow development and marketing of such systems are examined. C.K.D.

A77-39835 Options for the conversion of fossil fuels. E. J. Gornowski (Exxon Research and Engineering Co., Linden, N.J.). In: Energy and the environment: A risk benefit approach. New York, and Oxford, Pergamon Press, 1976, p. 185-204; Discussion, p. 204-206.

An overview of options available for the development of oil shale and coal resources is presented. Available sources are estimated, and technological problems associated with their utilization are discussed. Coal gasification and the production of synthetic fuels from synthesis gas are considered, together with the hydrogenation of coal to make liquid hydrocarbons. The conversion of coal to electricity is discussed, with special attention to the problems of sulfur dioxide pollution and of waste heat. Cost estimates for different fossile-fuel conversion options are presented and compared. C.K.D.

A77-39836 U.S. options for a transition from oil and gas to synthetic fuels. A. S. Manne (Harvard University, Cambridge, Mass.). In: Energy and the environment: A risk benefit approach. New York and Oxford, Pergamon Press, 1976, p. 207-245. 17 refs. NSF Grant No. SOC-75-05288.

A linear programming model used to obtain a minimum-cost strategy for meeting future energy demands with or without a given synthetic fuels technology is described. The model has been used to estimate the economic incentive for research and development efforts on synthetic fuels from coal, nuclear and advanced technologies. The costs and timing of transitions between four alternative fuel bases - petroleum and natural gas, coal-based synthetic fuels, hydrogen produced by electrolysis and hydrogen produced through high-temperature nuclear reactors coupled to fast breeders - are analyzed and discussed. C.K.D.

A77-39976 Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports (Sonnenenergie: Anwendungen, Systeme, Erfahrungen; Vortrags- und Diskussions-Veranstaltung, Essen, West Germany, February 4, 1977, Vorträge). *Meeting supported by the* Arbeitsgemeinschaft Solarenergie. Essen, Arbeitsgemeinschaft Solarenergie, 1977. 77 p. In German. (For individual items see A77-39977 to A77-39990)

The technology and the principles of operation of solar collectors are considered along with the possibilities for the solar air conditioning of buildings, the use of plastics in systems of solar technology, the utilization of solar energy for power-supply applications, and the future of solar-thermal small-scale power stations. Attention is also given to the solar system in the solar house Dornier/RWE in Essen, aspects concerning the design and the operation of solar houses, problems of energy storage related to the utilization of solar energy for space heating, heat pumps in solar installations, the calculation and optimization of solar-energy systems which provide hot water, and a study concerning the economy of solar heating systems. G.R.

A77-39977 Solar collectors - Technology and principles of operation (Solarkollektoren - Technik und Wirkungsweise). P. Kalischer (Energietechnik GmbH, Essen, West Germany). In: Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports. (A77-39976 18-44) Essen, Arbeitsgemeinschaft Solarenergie, 1977, p. 9-16. In German.

Solar collector systems which utilize optical systems for a concentration of solar radiation are briefly examined. A disadvantage of such systems, particularly for the latitude of Central Europe, is related to the fact that solar energy which is in the form of diffuse radiation is not concentrated on the absorber surface. Efforts related to the utilization of solar energy in West Germany are, therefore, mainly directed towards the development of appropriate flat plate collectors. Attention is given to the 'classical' flat plate collector, the heat-pipe collector, a flat plate collector with vacuum insulation, the efficiency of flat plate collectors, approaches for the enhancement of the energy output, and operational requirements. Examples of collector employment are related to the heating of a swimming pool, the heating of water, space heating, and air conditioning applications. G.R.

A77-39978 Possibilities for the solar air conditioning of buildings (Möglichkeiten zur solaren Klimatisierung von Gebäuden). K.-P. Schubert (Dornier-System GmbH, Friedrichshafen, West Germany). In: Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports. (A77-39976 18-44) Essen, Arbeitsgemeinschaft Solarenergie, 1977, p. 17, 18. In German.

A classification of air conditioning systems with different characteristics is considered. Absorption-type systems are currently almost exclusively used for air conditioning units based on the utilization of solar energy. The operational performance of a system with a lithium bromide refrigeration unit is discussed. Attention is given to aspects of collector performance as a function of the time of

day, collector design considerations, and a cost analysis comparing a solar and a conventional air conditioning system. G.R.

A77-39979 **Plastics in systems of solar technology (Kunststoffe in Systemen der Solartechnik).** H. Röber (Hoechst AG, Frankfurt am Main, West Germany). In: Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports. (A77-39976 18-44) Essen, Arbeitsgemeinschaft Solarenergie, 1977, p. 19-24. In German.

Suitable plastics for a use in systems of solar technology are listed in a table. Appropriate plastics for a use as cover material in solar collectors include foils consisting of ethylene and tetrafluoroethylene copolymer and foils of polyester. The use of polymethyl methacrylate and polycarbonate covers is also considered. The spectral transmission characteristics of a suitable plastic material are examined. Plastics for absorbers and collector housing are discussed and attention is given to the employment of plastics for the design of heat-storage systems. G.R.

A77-39980 **Solar generators - Utilization of solar energy for power-supply applications (Solargeneratoren - Nutzung der Sonnenenergie zur Stromversorgung).** H.-W. Schümann (Telefunken AG, Wedel, West Germany). In: Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports. (A77-39976 18-44) Essen, Arbeitsgemeinschaft Solarenergie, 1977, p. 25-27. In German.

A description is presented of a thermal solar generator system with a maximum output of 10 kW which was developed by a West German company. A solar collector is used to transform solar radiation into heat which is transferred to water as operational medium of the thermal cycle. A suitable thermal engine and a three-phase, current generator are employed in the described system. The development of a modular generator concept based on the employment of solar cells is also discussed. Attention is given to use of large-area solar cells, made of an unconventional silicon base material, with an efficiency of 10%. G.R.

A77-39981 **The future of solar-thermal small-scale power stations (Die Zukunft solarthermischer Kleinkraftwerke).** M. Simon (Maschinenfabrik Augsburg-Nürnberg AG, Munich, West Germany). In: Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports. (A77-39976 18-44) Essen, Arbeitsgemeinschaft Solarenergie, 1977, p. 28-30. In German.

Electric power requirements in areas without a power distribution system can in many cases be only economically satisfied with the aid of decentralized small-scale solar energy systems. It is estimated that there is a worldwide demand of about one million units for solar power stations with a power output in the range from 15 to 500 kW. Such stations could provide power for air conditioning applications and the desalination of sea water. Such a desalination could become of vital importance for desert or semidesert areas. The development of suitable solar power stations in West Germany is discussed. The considered system makes use of a cylinder-parabolic mirror with a steel tube in the focal line. Steam which is to be heated flows through the steel tube. An assembly of modular units to systems which provide the required power output is possible. The steam is to be stored in an insulated energy storage unit. When needed, the steam can be used for the operation of a steam engine. Two types of steam engines are considered. G.R.

A77-39982 **The Philips energy-experimentation house - Results and experience (Das Philips Energie-Experimentierhaus - Ergebnisse und Erfahrungen).** R. Bruno, W. Hermann, H. Hörster, R. Kersten, K. Klinkenberg, and F. Mahdjuri (Philips GmbH, Hamburg, West Germany). In: Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports. (A77-39976 18-44) Essen, Arbeitsgemeinschaft Solarenergie, 1977, p. 31-34. In German.

A description is presented of intermediate results obtained in a project reported by Bruno et al. (1976). The project involves investigations related to the utilization of solar energy and the efficient use of energy in buildings. Approaches for the reduction of the energy consumption in buildings are discussed, taking into account the reduction of heat losses, a utilization of waste heat, and the employment of systems for the direct and indirect utilization of solar energy. An indirect utilization of solar energy makes use of energy stored in the ground. The direct utilization of solar energy is based on the employment of evacuated collectors on the roof. It is found that a house can be heated to a large degree by means of solar energy if heat losses from the house are avoided with the aid of the considered approaches. G.R.

A77-39983 **The solar system in the solar house Dornier/RWE in Essen (Das Solarsystem im Solarhaus Dornier/RWE in Essen).** H. Gehrke (Dornier-System GmbH, Friedrichshafen, West Germany). In: Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports. (A77-39976 18-44) Essen, Arbeitsgemeinschaft Solarenergie, 1977, p. 35-37. In German.

The considered project has the objective to obtain experimental data concerning the possibilities and limitations of a use of solar energy in Central Europe. The investigation makes use of a one-family house at the outskirts of Essen, West Germany. The house has an active solar-energy collector area of 65 sq m, 7 cu m storage capacity, and a heat pump. The characteristics of the solar collector are discussed, taking into account the heat-pipe type of operation. Questions of system design are considered and a description is given of the operation of the system. G.R.

A77-39984 **The BBC solar house - Design and experience (Das BBC-Solarhaus - Aufbau und Betriebserfahrungen).** B. Ziegenbein (Brown, Boveri et Cie. AG, Walldorf, West Germany). In: Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports. (A77-39976 18-44) Essen, Arbeitsgemeinschaft Solarenergie, 1977, p. 38-40. In German.

The considered house, which was built in spring 1976 in Walldorf near Heidelberg, West Germany, represents with regard to its appearance, living area, and energy requirements a typical modern one-family house. It tries to provide 2/3 of its annual energy requirements with the aid of solar energy. A conventional heating system is available in addition to the solar installation. Experimental energy values for different collector areas and storage space volumes are to provide a data base for a cost-optimal design of collector areas and storage space. Attention is given to the low-loss storage of heat at low storage temperatures, the employment of a heat pump, the use of low-temperature heating, the employment of latent heat storage systems, space cooling with solar energy, and a control problem. G.R.

A77-39985 **The MBB solar houses - Design, operation, and experience (Die MBB-Solarhäuser - Aufbau, Betrieb und Erfahrungen).** H. Grallert (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). In: Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports. (A77-39976 18-44) Essen, Arbeitsgemeinschaft Solarenergie, 1977, p. 41-45. In German.

The considered solar houses are employed for functional testing, purposes of demonstration, the determination of the most suitable installation parameters, the testing of the long-term behavior of materials and types of construction, and the study of the interaction between the insulation characteristics of the house and the performance of solar heating. The phases of construction of the two solar houses are discussed. Attention is given to the conduction of the measurements and the obtained results. G.R.

A77-39986 **Solar energy as contribution to the energy budget - Problems of storage (Sonnenenergie als Beitrag zum**

Energiehaushalt - Probleme der Speicherung). G. Dietrich (Kraftanlagen AG, Heidelberg, West Germany). In: Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports. (A77-39976 18-44) Essen, Arbeitsgemeinschaft Solarenergie, 1977, p. 49-52. 9 refs. In German.

The direct utilization of solar energy for space heating is related to an appropriate storage of energy. Solar energy received during the summer has to be stored for a use in winter. The technical solution of this problem is possible. The economic feasibility of such a solution, however, has to be investigated, taking into account the costs involved in the use of other forms of energy. A description is presented of the various forms of energy storage systems. Facilities which store the heat received during the day for a use at night are widely used. Facilities for a storage of energy from summer to winter are still rare. The characteristic data for various types of heat storage media are listed in a table. It is found that a further development of thermal storage technology in conjunction with advances in other technologies related to heat utilization will provide a promising base for many applications. G.R.

A77-39987 Heat pumps in solar installations (Wärmepumpen in Solaranlagen). K. Vielhaber (Robert Bosch GmbH, Wernau, West Germany). In: Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports. (A77-39976 18-44) Essen, Arbeitsgemeinschaft Solarenergie, 1977, p. 53-56. In German.

The withdrawal of heat from the thermal storage system of a solar installation during the heating period has the effect that the temperature of the storage medium is gradually decreased until a temperature value is reached which is too low for heating by the direct method. The employment of a heat pump makes it possible to utilize for heating also the heat energy which still remains in the storage unit. The advantages of a heating system which consists of a collector, a thermal storage unit, and a heat pump are discussed. The operation of such a system is illustrated with the aid of an example involving a demonstration house which has been built for the systematic investigation of the various factors involved in the employment of the considered heating system. The use of the outside air or the ground as energy reservoir is also studied. G.R.

A77-39988 Calculation and optimization of solar-energy systems which provide hot water (Berechnung und Optimierung von Sonnenenergie-Systemen zur Warmwasserversorgung). R. Bruno, W. Hermann, H. Hörster, R. Kersten, and F. Mahdjuri (Philips GmbH, Hamburg, West Germany). In: Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports. (A77-39976 18-44) Essen, Arbeitsgemeinschaft Solarenergie, 1977, p. 57-61. In German.

A description is presented of the results which had been obtained with the aid of a computer program that had been developed for a study of the performance of a solar hot-water supply system, taking into account the consumption of hot water in a household consisting of four persons. The investigation conducted is concerned with the design of a solar heating system which provides as much as possible of the energy required by the hot-water supply system, taking into consideration the given economical conditions. The investigation shows the importance of a high collector efficiency for the climatic conditions of West Germany. G.R.

A77-39989 The BBC Solarwatt system (Das BBC-Solarwatt-System). J. Miller (Brown, Boveri et Cie. AG, Walldorf, West Germany). In: Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports. (A77-39976 18-44) Essen, Arbeitsgemeinschaft Solarenergie, 1977, p. 62-64. In German.

A description is presented of a system which provides hot water for domestic use. The system utilizes solar energy as much as economically feasible and obtains additional energy, in case of an insufficient supply of solar energy, in form of electric energy in summer and in form of thermal energy from the central heating system in winter. Attention is given to aspects of appropriate collector design and installation. G.R.

A77-39990 Possibilities and limitations concerning the economy of solar heating systems (Möglichkeiten und Grenzen der Wirtschaftlichkeit von Solarheizungen). H. Schweig (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). In: Solar energy: Applications, systems, experience; Lecture and Discussion Meeting, Essen, West Germany, February 4, 1977, Reports. (A77-39976 18-44) Essen, Arbeitsgemeinschaft Solarenergie, 1977, p. 65-74. In German.

The cost of a solar heating system is considered, taking into account the flat-plate collectors, the central control unit, thermal storage units, the pipe system, and the installation of the system. Currently available economically priced collectors are of comparatively low efficiency. Collectors with a higher efficiency are being developed in the laboratory. The great disadvantage of highly efficient collectors, which utilize a number of approaches including IR-reflectors and vacuum, is the high price. However, considerable reductions in price are expected in a number of years. Attention is given to the heat requirements of one-family and two-family houses, the characteristics of the available heating systems, and a general evaluation of the economy of solar heating systems. G.R.

A77-40028 * Sulfidation of 310 stainless steel at sulfur potentials encountered in coal conversion systems. D. B. Rao (NASA, Ames Research Center, Moffett Field; California, University, Berkeley, Calif.) and H. G. Nelson (NASA, Ames Research Center, Moffett Field, Calif.). In: Symposium on Properties of High Temperature Alloys with Emphasis on Environmental Effects, Las Vegas, Nev., October 17-22, 1976, Proceedings. (A77-40012 18-26) Princeton, N.J., Electrochemical Society, Inc., 1976, p. 464-492. 25 refs. NASA-ERDA-supported research.

The sulfidation of SAE 310 stainless steel was carried out in gas mixtures of hydrogen and hydrogen sulfide over a range of sulfur potentials anticipated in advanced coal gasification processes. The kinetics, composition, and morphology of sulfide scale formation were studied at a fixed temperature of 1065 K over a range of sulfur potentials from .00015N/sqm to 900N/sqm. At all sulfur potentials investigated, the sulfide scales were found to be multilayered. The relative thickness of the individual layers as well as the composition was found to depend on the sulfur potential. The reaction was found to obey the parabolic rate law after an initial transient period. Considerably longer transient periods were found to be due to unsteady state conditions resulting from compositional variations in the spinel layer. (Author)

A77-40029 Corrosion behavior of materials for coal-gasification applications. K. Natesan and O. K. Chopra (Argonne National Laboratory, Argonne, Ill.). In: Symposium on Properties of High Temperature Alloys with Emphasis on Environmental Effects, Las Vegas, Nev., October 17-22, 1976, Proceedings. (A77-40012 18-26) Princeton, N.J., Electrochemical Society, Inc., 1976, p. 493-510. 11 refs. ERDA-supported research.

The paper reports a thermodynamic analysis of phase stability in commercial alloys such as Type 304 stainless steel, Incoloy 800, and Inconel 671 upon exposure to gas environments anticipated in different coal-gasification processes. The analysis showed that a high chromium content in the alloy is beneficial for corrosion resistance in these environments, while nickel limits this trait. Scanning-electron micrographs of alloy samples which have been exposed to the gases are presented. The results indicate that under oxidizing conditions the alloys can develop a protective chromium-rich oxide layer which prevents both sulfidation and carburization. However, under marginally oxidizing and reducing conditions, the alloys exhibited extensive sulfidation and carburization. M.L.

A77-40042 Metal dusting corrosion in coal gasification environments. R. A. Perkins, W. C. Coons (Lockheed Research

Laboratories, Palo Alto, Calif.), and F. J. Radd (Continental Oil Co., Ponca City, Okla.). In: Symposium on Properties of High Temperature Alloys with Emphasis on Environmental Effects, Las Vegas, Nev., October 17-22, 1976, Proceedings. (A77-40012 18-26) Princeton, N.J., Electrochemical Society, Inc., 1976, p. 733-749. 6 refs. Research supported by the American Gas Association, Stearns-Roger Corp., Conoco Coal Development Co., and ERDA.

A form of metal dusting corrosion occurs in heat exchanger pipes of Type 321 Stainless and Incoloy 800 in coal gasification environments. Metallurgical analyses, consisting of optical microscopy, electron microprobe scans, and X-ray diffraction studies, were conducted on test samples cut from selected sections of heat exchanger coils after various periods of operation under a wide range of gas compositions and temperatures. Pitted areas were found to be heavily carburized and covered with iron-oxide rich scales containing metal particles. Unpitted areas were protected by chromic oxide scales. The corrosion mechanisms involve Cr depletion, rapid carburization, and selective oxidation. Attack of this type in coal gasification atmosphere can be prevented by addition of steam to the gas mixture. C.K.D.

A77-40149 # **Meteorological effects on solar cells.** J. R. Mallinson and P. T. Landsberg (Southampton, University, Southampton, England). *Royal Society (London), Proceedings, Series A,* vol. 355, no. 1680, June 30, 1977, p. 115-130. 28 refs. Research supported by the Science Research Council and NATO.

Physical principles of solar cells are examined with special reference to certain meteorological aspects. A solar-cell model is described which includes effects of surface recombination at the front and back surfaces, an ohmic contact at the back surface, and a nonconstant doping profile. This model is used to determine the I-V characteristics of a solar cell, to select the optimal load resistance, and to calculate the optimum output power. The value of the energy gap giving maximum efficiency for various spectral radiation distributions is investigated for meteorological conditions that change from a bright 'clear' day to an average 'cloudy' day and from a 'clear' day with lower solar altitude, more atmospheric vapor, or both, than in the former case, to a 'cloudy' day with thinner cloud cover. The energy-gap dependence of maximum efficiency is evaluated for silicon, a variable-gap silicon-type material, and a fixed-gap silicon-type material. It is concluded that a cell with an energy gap of 1.78 eV leads to maximum or near-maximum performance in all cases, including that where the diffuse radiation component amounts to approximately 60%. F.G.M.

A77-40201 # **Dynamic characteristics of the desulfurization plant boiler draft system for power stations.** S. Inoue and T. Abe. *Ishikawajima-Harima Engineering Review,* vol. 17, May 1977, p. 297-300. In Japanese, with abstract in English.

Two desulfurization plants are used at the Isogo Power Station. The station (265,000 kW x 2 units) is provided with two coal-fired boilers employing the balanced draft system. The boiler draft system has by-pass dampers installed around the desulfurization plant. In case of trouble in the desulfurization plant, the by-pass dampers will be actuated to open quickly; and thereby the boiler furnace draft will fluctuate. A simulation is carried out to obtain the dynamic characteristics such as the draft fluctuation of the boiler draft system, which will appear until the boiler exhaust gas fan trip for the desulfurization plant and the by-pass dampers open. (Author)

A77-40349 # **Types of city development, energy supply, and possibilities for optimization (A varosfejlesztes valtozatai, az energiaellatas es optimalas lehetosegei).** P. Karady (Energiagazdalkodasi Intezet, Hungary). *Energia es Atomtechnika,* vol. 30, May 1977, p. 219-224. 6 refs. In Hungarian.

The interaction between the availability of power and energy and the development of cities is discussed on examples of cities from antiquity to the present. The power needs of modern cities are discussed. The need for city development as a system is stressed. P.T.H.

A77-40350 # **Energy assessment and possibilities of remote heat supply (A tavolsagi hoellatas energetikai megitelese es lehetosegei).** B. Gergely. *Energia es Atomtechnika,* vol. 30, June 1977, p. 282-285. 12 refs. In Hungarian.

Changes in the energy price structure have significantly affected the economic viability of remote heating systems. Heat generation and transportation over long distances is now in a more favorable relative position in the overall view of heat supply systems. An estimate of the heat production capacity of a typical remote heat supply system is made. P.T.H.

STAR ENTRIES

N77-22112# Advisory Group for Aerospace Research and Development, Paris (France).
VARIABLE GEOMETRY AND MULTICYCLE ENGINES
1976 459 p In ENGLISH; partly in FRENCH Presented at the 48th Meeting of the AGARD Propulsion and Energetics Panel held at the Ecole Nationale Superieure des Tech. Avancees, Paris, 6-9 Sep. 1976
(AGARD-CP-205) Avail: NTIS HC A20/MF A01

A broad variety of cycle investigations are presented along with work on geometry variation of individual engine components. Advanced performance for supersonic conventional takeoff and landing aircraft and VTOL aircraft, high speed turboprops, fuel conservation, low noise, low exhaust emission, and integrated control systems are among the topics discussed.

N77-22116# Motoren- und Turbinen-Union Muencnen G.m.b.H. (West Germany).
ADVANCED ENGINE DESIGN CONCEPTS AND THEIR INFLUENCE ON THE PERFORMANCE OF MULTI-ROLE COMBAT AIRCRAFT
H. Grieb and E. Ackermann *In* AGARD Variable Geometry and Multicycle Eng. 1976 15 p refs

Avail: NTIS HC A20/MF A01

Engine design concepts which combine the advantages of the reheated turbojet with the advantages of the reheated turbofan are considered. Emphasis is placed on the demands placed on the power plant by a multirole weapon system. Variable geometry and the penalty in engine weight and complexity are among the factors discussed. It is shown that the variable cycle engine improves the performance of multirole combat aircraft. Author

N77-22117# Naval Air Propulsion Test Center, Trenton, N.J.
VARIABLE CYCLE ENGINES FOR V/STOL FIGHTERS
John R. Facey and Fred C. Glaser (McDonnell Douglas Corp., St. Louis) *In* AGARD Variable Geometry and Multicycle Eng. 1976 10 p ref
Avail: NTIS HC A20/MF A01

The impact of variable cycle engines on advanced V/STOL multimission fighters was studied. A program description is given along with a summary of results and conclusions drawn from the initial phase of the program. Author

N77-22125# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
VARIABLE CYCLE ENGINE APPLICATIONS AND CONSTRAINTS
Robert J. Payzer *In* AGARD Variable Geometry and Multicycle Eng. 1976 13 p
Avail: NTIS HC A20/MF A01

The potential applications for variable cycle engines are discussed along with the payoffs for variable cycle engines and the constraints on these engines both from a totally installed aspect, as well as the internal engine restrictions. Author

N77-22126# United Technologies Corp., East Hartford, Conn.
HIGH EFFICIENCY ENGINE CYCLES FOR AIR TRANSPORT FUEL ECONOMY
D. E: Gray *In* AGARD Variable Geometry and Multicycle Eng. 1976 10 p refs
Avail: NTIS HC A20/MF A01

The effects of projected gas turbine technological progress, unconventional thermodynamic processes, and advanced propulsion devices are assessed in terms of their fuel savings potential. The operating characteristics of two selected propulsion systems - an advanced turbofan and a turboprop engine - are projected and compared at points along a transport flight profile. The applicability of engine component geometry variation to improve propulsion system efficiency is also reviewed. Author

N77-22127# Hamilton Standard, Windsor Locks, Conn.
MULTI-MISSION USES FOR PROP-FAN PROPULSION
A. H. Jackson and B. S. Gatzen *In* AGARD Variable Geometry and Multicycle Eng. 1976 12 p refs

Avail: NTIS HC A20/MF A01

Advanced turboprops or Prop-Fans are considered in terms of major reductions in fuel consumption. Aerodynamics, noise reduction, and structural design are discussed along with engine design and applications. J.M.S.

N77-22128# Rolls-Royce Ltd., Bristol (England). Aero Div.
VARIABLE GEOMETRY IN THE GAS TURBINE - THE VARIABLE PITCH FAN ENGINE
R. M. Denning *In* AGARD Variable Geometry and Multicycle Eng. 1976 10 p refs

Avail: NTIS HC A20/MF A01

A specific example of a variable pitch engine, the M45SD-02, is examined. Wide speed range, high relative takeoff thrust, low noise, steep approach path control, fuel efficiency, and reverse thrust capability are among the characteristics discussed. Potential applications for the variable pitch engine are included. J.M.S.

N77-22130# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Aircraft Div.
THE INTERMITTENT JET FOR SUPERSONIC CONDITIONS INCREASED WITH PASSAGE TO OPERATING IN A RAMJET - A LOW COST ENGINE [LE PULSO-REACTEUR POUR REGIME SUBSONIQUE ELEVE AVEC PASSAGE AU FONCTIONNEMENT EN STATO-REACTEUR - UN MOTEUR DE FAIBLE PRIX DE REVIENT]
W. K. Eick *In* AGARD Variable Geometry and Multicycle Eng. 1976 27 p refs In FRENCH

Avail: NTIS HC A20/MF A01

The results of preliminary studies made on a jet engine without a safety-valve are reported. Essential parameters were studied in detail to determine their influence on thrust characteristics and fuel consumption. Transl. by B.B.

N77-22131# Pisa Univ. (Italy).
PERFORMANCE CHARACTERISTICS OF TURBO-ROCKETS AND TURBO-RAMJETS USING HIGH ENERGY FUEL
Dino Dini *In* AGARD Variable Geometry and Multicycle Eng. 1976 30 p refs
Avail: NTIS HC A20/MF A01

The aerodynamic and thermodynamic behavior of turborockets and turboramjets is considered. By means of variable engine geometry, multicycle engines meet aircraft requirements for takeoff, climb, cruise, maneuver, loiter, and landing. Performance characteristics are evaluated for these conditions, taking into account variable geometry in some intake and exhaust configurations. Problems arising from future high energy fuels, particularly hydrogen, impose changes in interface components, geometry, and control. Preliminary designs of turborockets and turboramjets for military and civil applications are discussed. Author

N77-22140# Technische Hochschule, Munich (West Germany). Aerospace Inst.

THE PROS AND CONS OF VARIABLE GEOMETRY TURBINES

H. G. Muenzberg and J. Kurzke *In* AGARD Variable Geometry and Multicycle Eng. 1976 12 p ref

Avail: NTIS HC A20/MF A01

Analysis of the advantages of variable geometry turbines indicates that an adjustable stator in the low pressure of a two spool turbojet is of no explicit advantage. The shape of the compressor performance map could be so altered that, even in a simple example, a stator adjustment would result in an improvement of fuel consumption. In this case, stator adjustment proves to be advantageous. Such a result cannot be considered as generally valid, because only the characteristic of one specific engine can be altered, and then only in the form of a remedial measure. Variable geometry can be advantageous for flight missions in which the engine is run for long periods of time at a very low partial load. Author

N77-22141# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.

POTENTIAL IMPROVEMENTS IN ENGINE PERFORMANCE USING A VARIABLE GEOMETRY TURBINE

Robert J. May, Jr., Wayne A. Tall, and H. Ivan Bush *In* AGARD Variable Geometry and Multicycle Eng. 1976 16 p refs

Avail: NTIS HC A20/MF A01

Installed performance characteristics of a fixed geometry turbofan, a fixed geometry turbojet, and a variable geometry turbojet are compared for typical subsonic cruise, supersonic cruise and combat flight conditions. Results indicate that for applications where both subsonic and supersonic fuel consumptions are important, a variable geometry turbine turbojet can offer substantial reductions in fuel usage. Author

N77-22142# Rolls-Royce Ltd., Bristol (England). Bristol Engine Group.

VARIABLE FLOW TURBINES

R. J. Latimer *In* AGARD Variable Geometry and Multicycle Eng. 1976 6 p

Avail: NTIS HC A20/MF A01

Varying turbine flow capacity by restaggering the stator blades or by restricting the annulus is considered. A brief survey of research into controlling the turbine flow is given along with conclusions. J.M.S.

N77-22143# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).

EXPERIENCE WITH A ONE STAGE VARIABLE GEOMETRY AXIAL TURBINE

J. Hourmouziadis, K. Hagemeister, O. Rademacher, and H. Kolben *In* AGARD Variable Geometry and Multicycle Eng. 1976 9 p refs

Avail: NTIS HC A20/MF A01

Based on steady-state and transient performance characteristics of a two spool turboshaft engine, the possible improvements resulting from a variable geometry power turbine are discussed and the design requirements defined. The aerodynamic design of a turbine fulfilling these requirements is described, and the predicted power turbine characteristic is presented and compared with component test results. The design and development of the hot environment variable stator mechanism is described, including consideration of the vane positioning accuracy and response characteristics. Performance test results and the problems encountered with the turbine operating in a full scale engine are presented. Mechanical aspects such as the long term endurance capability of the variable stator mechanism, as well as vibrational problems of the rotor blading caused by the variable geometry, are discussed. Author

N77-22263# Brookhaven National Lab., Upton, N.Y.

CONCRETE-POLYMER MATERIALS FOR GEOTHERMAL APPLICATIONS Progress Report, Oct. - Dec. 1975

1975 22 p refs

(Contract E(30-1)-16)

(BNL-20865; PR-7) Avail: NTIS HC A02/MF A01

The availability of durable and economic materials of construction for handling hot brine and steam is a serious problem in the development of geothermal energy. The standard grouting materials used to cement well casings into the ground are severely attacked by brine and steam at temperatures greater than 200 C. Progress in the research program to determine if concrete-polymer composite materials can be utilized in geothermal power systems, initiated in April 1974, is reported. Author (ERA)

N77-22270# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.

ANTIWEAR ADDITIVES, WEAR STUDIES ON CHEMICAL ADDITION AGENTS FOR IMPARTING AN EFFECTIVE LUBRICATING RESPONSE IN POLYSILOXANE (SILICONE) FLUIDS Progress Report

James L. Hammond and Alfeo A. Conte, Jr. 2 Jul. 1976 56 p refs

(AD-A033527; NADC-76226-30) Avail: NTIS HC A04/MF A01 CSCL 11/8

An additive package based on chlorendate and thiadiazole molecular structures has been discovered which imparts antiwear properties to tetrachlorophenylmethyl siloxane fluids that have been previously unattainable. For the first time a polysiloxane based fluid possessing antiwear properties comparable to such outstanding lubricants as petroleum oils, synthetic hydrocarbons, diesters and phosphate esters was formulated. In addition, a detailed analysis of the modification of friction surfaces (steel-on-steel) using organophosphate addition agents in polysiloxane fluids has refuted the commonly held belief that the inability of antiwear additives to function in polysiloxane media at low concentrations is due to the fact that the additive is substantially excluded from the surface. Evidence is presented to show that additive-surface interactions are indeed prevalent resulting in an antagonistic (pro-wear) action. In one specific instance depending on load and concentration a beneficial lubricating response is achieved with a tetrachlorophenylmethyl siloxane fluid containing alkyl-phosphate derivatives. The use of organo-phosphates as antiwear agents in polysiloxane has previously proved unfruitful, therefore, these results represent a significant area for further study. GRA

N77-22290*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

HYDROGEN-ENRICHMENT-CONCEPT PRELIMINARY EVALUATION Final Report

E. Ecklund 15 Dec. 1975 221 p refs Sponsored by NASA, ERDA and EPA

(NASA-CR-152814; JPL-1200-237; TEC-75/007) Avail: NTIS HC A10/MF A01 CSCL 21D

A hydrogen-enriched fuels concept for automobiles is described and evaluated in terms of fuel consumption and engine exhaust emissions through multicylinder (V-8) automotive engine/hydrogen generator tests, single cylinder research engine (CFR) tests, and hydrogen-generator characterization tests. Analytical predictions are made of the fuel consumption and NO/sub x/ emissions which would result from anticipated engine improvements. The hydrogen-gas generator, which was tested to quantify its thermodynamic input-output relationships was used for integrated testing of the V-8 engine and generator. ERA

N77-22291# Battelle Pacific Northwest Labs., Richland, Wash.

POTENTIAL FOR PRODUCING AND MARKETING GASOLINE SUBSTITUTES FROM WESTERN COAL

J. W. Currie and D. J. Braun Sep. 1976 57 p refs

(Contract E(45-1)-1830)

(BNWL-2080(RAP-4)) Avail: NTIS HC A04/MF A01

A multisector model with regional detail was required to thoroughly assess the likelihood of commercial-scale liquefaction occurring in Montana and Wyoming under market conditions.

Significant information was obtained from a constrained partial analysis. Some fundamental terminology used in this analysis is reviewed. Future demand and potential supply of gasoline from domestic crude oil are treated. The costs of supplying synthetic gasoline and methanol from western coal as well as the qualitative aspect of these fuels are examined. The supply and demand functions are solved simultaneously under various import schemes to trace out a family of gasoline-market equilibrium price curves over time. Three scenarios are then analyzed by comparing the costs of supplying synthetic fuels with the market equilibrium prices for gasoline. Market potential for the synthetic fuels is estimated for a wide range of coal prices. ERA

N77-22292# Federal Energy Administration, Washington, D. C. Office of Energy Information and Analysis.

PETROLEUM MARKET SHARES: A REPORT ON SALES OF DISTILLATE AND RESIDUAL FUEL OIL TO ULTIMATE CONSUMERS, 1975

Jun. 1976 57 p refs

(PB-260565/7; FEA/B-76/352) Avail: NTIS HC A04/MF A01 CSCL 21D

Nationally, refiner-marketers sold approximately 42 percent of their distillate fuel oil in 1975 to ultimate consumers (i.e., end-users and wholesale purchasers-consumers), and 58 percent of their volume to independent marketers as either branded or nonbranded product. Refiner-marketers sold nationally approximately 80 percent of their 1975 residual fuel to ultimate consumers and 20 percent of their volume to independent marketers as branded or nonbranded product. GRA

N77-22293# University Engineers, Inc., Norman, Okla.

SMALL SCALE TESTS ON CONTROL METHODS FOR SOME LIQUEFIED NATURAL GAS HAZARDS Final Report

L. E. Brown, W. E. Martinsen, S. P. Muhlenkamp, and G. L. Puckett May 1976 81 p refs

(Contract DOT-CG-42355-A)

(AD-A033522; UE-308-FR; USCG-D-95-76) Avail: NTIS HC A05/MF A01 CSCL 11/7

A report of results of small scale (100 square ft) tests of some liquefied natural gas (LNG) hazard control methods and concepts. Tests were run to estimate dry chemical flow rate requirements for the extinguishment of fires from LNG pools with obstructions in the pool area and fires from LNG pools on water in a containment. Objectives were to obtain data for design of large-scale tests. Other small-scale tests examined the feasibility of other concepts for controlling hazards from spills of liquefied natural gas. Agent application rates required for extinguishment of obstructed LNG fires and LNG fires on water are not different from those effective on unobstructed fires on dry surfaces (if the functionality between burning rate and application rate is accounted for). Care must be exercised to assure uniform powder distribution on obstructed fires. Tests of water spray screens to reduce downwind vapor concentrations showed that the concept is practical and effective for small LNG spills, and that the mechanism of reduction is the addition of turbulence in the vapor zone. Tests of water spray screens to reduce radiant heating of exposures demonstrated no practical value for the concept except as an uneconomical alternative where spray directly on the exposure is not possible. Author (GRA)

N77-22294# Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.

STRATEGIC PETROLEUM RESERVE. FINAL ENVIRONMENTAL IMPACT STATEMENT FOR BAYOU CHOCTAW SALT DOME

Dec. 1976 613 p refs

(PB-261984/9; FEA/S-76/501) Avail: NTIS HC A99/MF A01 CSCL 21D

The purpose of the SPR is to mitigate the economic impacts of any future interruptions of the petroleum imports. The Bayou Choctaw site, a salt dome with existing cavities located in Iberville Parish, Louisiana, was identified as a candidate site for the ESR because it offers the advantage of large storage capacity, easy access to the distribution network, and a relatively short preparation period. This site-specific EIS analyzes the environmental impacts caused by site preparation and operation. GRA

N77-22295# Pennsylvania State Univ., University Park. Dept. of Mineral Economics.

HISTORICAL TRENDS IN COAL UTILIZATION AND SUPPLY Final Report

Richard L. Gorden and George H. K. Schenck Aug. 1976 631 p refs

(Grant DI-BM-G0 155116)

(PB-261278/6; BM-OFR-121-76) Avail: NTIS HC A99/MF A01 CSCL 21D

Historical behavior of coal consumption, the forces that are affecting prospective coal use, and various scenarios of future consumption in selected markets were considered. GRA

N77-22297# Oak Ridge National Lab., Tenn. Thermonuclear Div.

CRYOGENIC POWER TRANSMISSION TECHNOLOGY: CRYOGENIC DIELECTRICS Quarterly Report, 1 Jan. - 31 Mar. 1976

Jul. 1976 72 p refs

(Contract W-7405-eng-26)

(ORNL/TM-5498; QR-13) Avail: NTIS HC A04/MF A01

Partial discharge inception and extinction were measured in various three-layer polymer film samples impregnated with pressurized cold helium gas. The behavior of the inception voltage is described with respect to variations in temperature, pressure, electrode geometry, and location of voids adjacent to the electrodes or midway through the dielectric. Preliminary dc breakdown tests on some of the same samples resulted in external flashover on the sample chamber rather than internal breakdown, but established a lower limit to the dc dielectric strength. The status of experimental equipment is reported, including improvements to low temperature thermometry instrumentation. The first of a series of bimonthly meetings was held to promote discussion of cryogenic dielectric problems between members of various superconducting power transmission line development projects. ERA

N77-22393# California Univ., Berkeley. Lawrence Berkeley Lab.

RESISTANCE OF SUPERCONDUCTING-NORMAL METAL-SUPERCONDUCTING SANDWICHES Ph.D. Thesis

M. L. Rappaport Sep. 1976 200 p refs

(Contract W-7405-eng-48)

(LBL-5473) Avail: NTIS HC A09/MF A01

The resistance, R, of superconducting-normal, metal-superconducting (SNS) sandwiches was measured as a function of temperature, T, and measuring current, I, usually from 20 mK to T/sub cS/. A semi-phenomenological theory for the resistance of these sandwiches below T less than or or equal to 1 K which includes both temperature and current dependence was derived using the de-Gennes theory of the proximity effect and the idea of Andreev reflection. Comparing experimental and theoretical R vs T curves for T less than or equal to 1 K allows estimation of the magnitude of the pair potential in N. ERA

N77-22398# TRW Defense and Space Systems Group, Redondo Beach, Calif.

DEVELOPMENT PROGRAM FOR SOLID ELECTROLYTE BATTERIES Final Report, 1 Jul. 1975 - 30 Apr. 1976

Herbert P. Silverman, Lynn S. Marcoux, and Eddie T. Seo Sep. 1976 104 p refs

(PB-260719/0; EPRI-EM-226) Avail: NTIS HC A06/MF A01 CSCL 10C

The results of sodium-sulfur battery program are presented. The long-range objective of the program was the development and commercialization of sodium-sulfur battery for electric utility energy storage. The study demonstrated that the major challenges of developing the sodium-sulfur battery into a commercially viable energy-storage system are: (1) development of corrosion resistant

sulfur-electrode containers; (2) design and development of a less highly stressed seal; (3) fabrication of long-life electrolytes; and (4) design of cells capable of full utilization of the active positive-electrode material (sulfur). GRA

N77-22408# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
HIGH POWER STUDY, SUPERCONDUCTING GENERATORS Final Report, 2 Jun. 1975 - 1 Mar. 1976
A. E. King, C. C. Kouba, J. L. McCabria, and L. D. Smith 1 Mar. 1976 220 p refs
(Contract F33615-75-C-2068)
(AD-A031620; AFAPL-TR-76-37) Avail: NTIS HC A10/MF A01 CSCL 10/2

This report summarizes the results of a design study of light weight, high power electrical generators in the 10 to 50 Megawatt range with output voltages up to 200 kV dc (after rectification). Superconducting machines representing the latest technology were the focus of the study; non-superconducting machines utilizing the most advanced conventional design technologies were also studied to develop comparable performance data. Turbine requirements and integration features were studied to assure compatibility. A separate analysis of MHD electrical generator designs was also carried out to highlight comparable performance data for that type of power source. Author (GRA)

N77-22422*# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.
AN INVESTIGATION OF ELECTROHYDRODYNAMIC HEAT PIPES Final Report
R. I. Loehrke Mar. 1977 51 p refs
(Grant NGR-06-002-127)
(NASA-CR-151977) Avail: NTIS HC A04/MF A01 CSCL 20D

The principles of electrohydrodynamic heat pip operation are first discussed. Evaporator conductance experiments are then described. A heat pipe was designed in which grooved and ungrooved evaporator surfaces could be interchanged to evaluate the necessity of capillary grooves. Optimum electrode spacing was also studied. Finally, heat convection in evaporating thin films is considered. D.M.L.

N77-22432# Hawaii Univ., Honolulu. Dept. of Mechanical Engineering.
SIMILARITY SOLUTIONS FOR MIXED CONVECTION FROM HORIZONTAL IMPERMEABLE SURFACES IN SATURATED POROUS MEDIA
Ping Cheng Aug. 1976 24 p refs
(Contract E(04-3)-1093; Grant NSF GI-38319)
(PB-261561/5; HGP-TR-16; NSF/RA-760375) Avail: NTIS HC A02/MF A01 CSCL 08I

Boundary layer analysis is performed for mixed convection about a horizontal flat plate in a saturated porous medium with aiding external flows, where the governing parameter is found to be Ra /(Re Pr) to the 3/2 power. Similarity solutions are obtained for horizontal flat plates at zero angle of attack with constant heat flux, and stagnation point flows about horizontal flat plates with wall temperature varying as (T sub W) alpha (x squared). Temperature and velocity profiles for these two cases at selected values of Ra /(Re Pr) to the 3/2 power are presented. GRA

N77-22469# Princeton Univ., N.J. Plasma Physics Lab.
OPTIMIZATION OF FUSION-DRIVEN FISSIONING SYSTEMS
R. G. Mills and D. L. Chapin Oct. 1976 10 p refs Presented at the Joint US-USSR Symp. on Fusion-Fission Hybrid Reactors, Livermore, Calif., 13 Jul. 1976
(Contract E(11-1)-3073)
(PPPL-1285; Conf-760733-5) Avail: NTIS HC A02/MF A01

Potential advantages of hybrid or fusion/fission systems can be exploited in different ways. With selection of the U-238-Pu-239 fuel cycle, it is show that the system has greatest value as a power producer. Numerical examples of relative revenue from power production vs. Pu-239 production are discussed, and possible plant characteristics described. The analysis tends to show that the hybrid may be more economically attractive than pure fusion systems. ERA

N77-22484*# National Aeronautics and Space Administration, Washington, D. C.
SAFETY FLYWHEEL Patent Application
Richard T. Schneider, inventor (to NASA) (Fla. Univ., Gainesville) Filed 17 Jan. 1977 11 p Sponsored by NASA
(NASA-Case-HQN-10888-1; US-Patent-Appl-SN-760057) Avail: NTIS HC A02/MF A01 CSCL 13I

An inertial energy storage device is disclosed employing a safety flywheel which is made of flexible material such as a twisted rope ring. The rigidity required for such a device is achieved through centrifugal forces inherent in such a device when it is operating. A small number of the strands of the rope ring have a tensile strength that is lower than the vast majority of the strands of the rope ring whereby should any of these strands fail, they will begin to whiplash allowing such a failure to be detected and braked before a catastrophic failure occurs. This is accomplished by the inclusion of glass tubes located around the periphery of the flywheel. The tubes are in communication with a braking fluid reservoir. The flywheel and glass tubes are enclosed within a vacuum-tight housing. NASA

N77-22490# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
PERFORMANCE OF ARMY ENGINES WITH UNLEADED GASOLINE-FIELD STUDY EVALUATION Final Report
John D. Tosh Oct. 1976 118 p refs
(Contracts DAAK02-75-C-0082; DAAD05-72-C-0427)
(AD-A032075; AFLRL-82) Avail: NTIS HC A06/MF A01 CSCL 21/4

All gasoline-powered vehicles and equipment at six U.S. Army installations were operated during the evaluation period on VV-G-001690A Regular Grade unleaded gasoline. Special Grade 91.0 RON unleaded gasoline was specified but was unavailable; therefore, unleaded gasoline in the 92.0-94.0 RON range was used throughout the program. During this evaluation period, no detrimental effects were noted on material handling equipment (MHE), engineer support equipment, or commercial, tactical, or combat vehicles operated under typical daily military operation. Also, no increases in maintenance operating costs were noted during this evaluation. Author (GRA)

N77-22587# Hawaii Univ., Honolulu. Dept. of Mechanical Engineering.
THE INFLUENCE OF LATERAL MASS EFFLUX ON FREE CONVECTION BOUNDARY LAYERS IN A SATURATED POROUS MEDIUM
Ping Cheng 28 Apr. 1976 23 p refs
(Contract E(04-3)-1093; Grant NSF GI-38319)
(PB-261558/1; HGP-TR-13; NSF/RA-760372) Avail: NTIS HC A02/MF A01 CSCL 08I

The effects of lateral mass efflux with prescribed temperature and velocity on vertical free convection boundary layers in a saturated porous medium at high Rayleigh numbers are studied. Within the framework of boundary layer theory, similarity solutions are obtained for the special case where the prescribed temperature and velocity of the fluid vary as (x to the lambda power) and (x to the power((lambda-1)/2)) respectively. The effects of mass efflux on surface heat transfer rate and boundary layer thickness are shown. Application to warm water discharge along a well or fissure to an aquifer of infinite extent is discussed. GRA

N77-22591# Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.
STRATEGIC PETROLEUM RESERVE PLAN (PUBLIC LAW 94-163, SECTION 154)
15 Dec. 1976 249 p
(PB-261737/1; FEA/S-76/458) Avail: NTIS HC A15/MF A01 CSCL 21D

The Energy Policy and Conservation Act requires the FEA to implement the Strategic Petroleum Reserve in order to mitigate the economic impacts of any future interruptions of petroleum imports. One hundred fifty MMB of oil will be stored by 1978 in the Early Storage Reserve, and five hundred MMB will be stored by 1982 under the full program. GRA

N77-22596# Hawaii Univ., Honolulu. Hawaii Geothermal Project.
LEGAL AND PUBLIC POLICY SETTING FOR GEOTHERMAL RESOURCE DEVELOPMENT IN HAWAII
Robert M. Kamins and Donald Kornreich Feb. 1976 102 p refs Sponsored by NSF and ERDA
(PB-262910/3; NSF/RA-760400) Avail: NTIS HC A06/MF A01 CSCL 08I

Social policy issues raised by the prospects for geothermal resource development in the state of Hawaii are considered. Exploration of the geothermal potential, legal considerations, regulation of geothermal resource exploitation, and state geothermal development policy are discussed. GRA

N77-22602# California Univ., Riverside. Inst. of Geophysics and Planetary Physics.
ON SHALLOW-HOLE TEMPERATURE MEASUREMENTS. A TEST STUDY IN THE SALTON SEA GEOTHERMAL FIELD
Tien-Chang Lee 1976 40 p refs
(Grant NSF AER-72-03551)
(PB-262643/0; IGPP-UCR-76-6; NSF/RA-760426) Avail: NTIS HC A03/MF A01 CSCL 08I

Two numerical methods based on non-linear least-squares curve fitting are derived to remove the effect of annual temperature wave at the ground surface. One method gives the gradient and diffusivity as a function of depth while the other gives the weighted average values. Experiments were carried out in six test holes cased with 2 cm O.D. pvc pipes in the Salton Sea geothermal field. GRA

N77-22603# Colorado School of Mines, Golden.
GEOTHERMAL EXPLORATION: AN EVALUATION OF THE MICROSEISMIC GROUNDNOISE METHOD Ph.D. Thesis
Jacob Jerome Skokan 1974 126 p refs
(PB-262575/4; T-1701; NSF/RA/N-74-318) Avail: NTIS HC A07/MF A01 CSCL 08I

An attempt to test the geothermal-groundnoise hypothesis--that is: geothermal reservoirs are dynamic systems and can be located by measuring ground motion above them-resulted in extensive groundnoise surveys in two areas which appear to have great geothermal potential. These surveys were carried out at Kilauea Volcano, and the East Rift of Kilauea Volcano, on the island of Hawaii. Even in this relatively ideal environment, the surveys indicated changes in the acoustic properties of rocks, rather than changes in groundnoise activity resulting from dynamic geothermal reservoirs. GRA

N77-22604# Little (Arthur D.), Inc., Cambridge, Mass.
OUTER CONTINENTAL SHELF OIL AND GAS COSTS AND PRODUCTION VOLUME: THEIR IMPACT ON THE NATION'S ENERGY BALANCE TO 1990 Final Report
Frederick W. Mansvelt Beck and Karl M. Wiig Jul. 1976 241 p refs
(Contract DI-08550-CTS-48)
(PB-262533/3; ADL-78526; BLM/SE-77-01) Avail: NTIS HC A11/MF A01 CSCL 08I

The costs of finding and producing oil and gas in the OCS, estimates of the quantities likely to be produced in 1980, 1985, and 1990 under various price scenarios, and estimates of the potential regional and national impact on energy demand and supply are given. The resource estimates for the Outer Continental Shelf provided by the USGS were for offshore areas with water not deeper than 600 feet. GRA

N77-22608*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PHOTOVOLTAIC SYSTEM TEST FACILITY ELECTROMAGNETIC INTERFERENCE MEASUREMENTS
J. A. Johnson, F. P. Herke, Jr., and W. D. Knapp Apr. 1977 12 p ref
(Contract E(49-26)-1022)
(NASA-TM-X-73640; E-9142; ERDA/NASA-1022/77/11) Avail: NTIS HC A02/MF A01 CSCL 10A

Field strength measurements on a single row of panels indicates that the operational mode of the array as configured presents no radiated EMI problems. Only one relatively significant frequency band near 200 kHz showed any degree of intensity (9 muV/m including a background level of 5 muV/m). The level was measured very near the array (at 20 ft distance) while Federal Communications Commission (FCC) regulations limit spurious emissions to 15 muV/m at 1,000 ft. No field strength readings could be obtained even at 35 ft distant. Author

N77-22609*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ERDA/LEWIS RESEARCH CENTER PHOTOVOLTAIC SYSTEMS TEST FACILITY
A. E. Forestieri, J. A. Johnson, W. D. Knapp, H. Rigo, J Stover, and R. Suhay Apr. 1977 34 p
(Contract E(49-26)-1022)
(NASA-TM-X-73641; E-9147; ERDA/NASA-1022/77/12) Avail: NTIS HC A03/MF A01 CSCL 10A

A national photovoltaic power systems test facility (of initial 10-kW peak power rating) is described. It consists of a solar array to generate electrical power, test-hardware for several alternate methods of power conversion, electrical energy storage systems, and an instrumentation and data acquisition system. Author

N77-22611*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A LIGHTWEIGHT SOLAR ARRAY STUDY
Robert H. Josephs 15 Feb. 1977 39 p refs
(Contract NAS7-100)
(NASA-CR-152676; JPL-Publ-77-3) Avail: NTIS HC A03/MF A01 CSCL 10A

A sample module was assembled to model a portion of a flexible extendable solar array, a type that promises to become the next generation of solar array design. The resulting study of this module is intended to provide technical support to the array designer for lightweight component selection, specifications, and tests. Selected from available lightweight components were 127-micron-thick wrap-around contacted solar cells, 34-micron-thick sputtered glass covers, and as a substrate a 13-micron-thick polyimide film clad with a copper printed circuit. Each component displayed weaknesses. The thin solar cells had excessive breakage losses. Sputtered glass cover adhesion was poor, and the covered cell was weaker than the cell uncovered. Thermal stresses caused some cell delamination from the model solar array substrate. Author

N77-22612*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN INITIAL COMPARATIVE ASSESSMENT OF ORBITAL AND TERRESTRIAL CENTRAL POWER SYSTEMS Final Report
Richard Caputo Mar. 1977 160 p refs
(Contract NAS7-100)
(NASA-CR-152688; JPL-Doc-900-780) Avail: NTIS HC A08/MF A01 CSCL 10A

Orbital solar power plants, which beam power to earth by microwave, are compared with ground-based solar and conventional baseload power plants. Candidate systems were identified for three types of plants and the selected plant designs were then compared on the basis of economic and social costs. The representative types of plant selected for the comparison are: light water nuclear reactor; turbines using low BTU gas from coal; central receiver with steam turbo-electric conversion and thermal storage; silicon photovoltaic power plant without tracking and including solar concentration and redox battery storage; and silicon photovoltaics. Author

N77-22613*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLAR ENERGY IN BUILDINGS: IMPLICATIONS FOR CALIFORNIA ENERGY POLICY
Alan S. Hirshberg and E. S. Davis Mar. 1977 136 p refs Sponsored in part by California Energy Resources Conservation and Development Commission
(Contract NAS7-100)
(NASA-CR-152686; JPL-Doc-5040-42) Avail: NTIS HC A07/MF A01 CSCL 10A

energy designs are described, as well as the sizing of solar energy systems and their performance. The cost of solar energy systems is given both at current prices and at prices consistent with optimistic estimates for the cost of collectors. The main institutional barriers to the wide spread use of solar energy are summarized. Author

N77-22614*# Duke Univ., Durham, N.C. School of Engineering.
A THEORY OF CONTROL FOR A CLASS OF ELECTRONIC POWER PROCESSING SYSTEMS: ENERGY-STORAGE dc-TO-dc CONVERTERS Ph.D. Thesis
William W. Burns, III 25 Apr. 1977 257 p refs
(Grant NGL-34-001-001)
(NASA-CR-152696) Avail: NTIS HC A12/MF A01 CSCL 10A

An analytically derived approach to the control of energy-storage dc-to-dc converters, which enables improved system performance and an extensive understanding of the manner in which this improved performance is accomplished, is presented. The control approach is derived from a state-plane analysis of dc-to-dc converter power stages which enables a graphical visualization of the movement of the system state during both steady state and transient operation. This graphical representation of the behavior of dc-to-dc converter systems yields considerable qualitative insight into the cause and effect relationships which exist between various commonly used converter control functions and the system performance which results from them. Author

N77-22615*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD FOR PRODUCING SOLAR ENERGY PANELS BY AUTOMATION Patent Application
John C. Evans, Jr., inventor (to NASA) Filed 25 Apr. 1977 24 p
(NASA-Case-LEW-12541-1; US-Patent-Appl-SN-790637) Avail: NTIS HC A02/MF A01 CSCL 10A

The solar cell panel is fabricated by photoetching a pattern of collector grid systems with appropriate interconnection and bus bar tabs into a glass or plastic sheet and then filling these regions with a first, thin conductive metal film followed by a layer of a mixed metal oxide such as InAsO or InSnO. A multiplicity of solar cells are bonded between the protective sheet at the sites of the collector grid systems and a backelectrode substrate by conductive metal filled epoxy to complete the fabrication of an integrated solar panel. NASA

N77-22617# Oak Ridge National Lab., Tenn.
THERMAL ENERGY STORAGE FOR BUILDING HEATING AND COOLING APPLICATIONS Quarterly Progress Report, Apr. - Jun. 1976
H. W. Hoffman and R. J. Kedl Nov. 1976 13 p
(Contract W-7405-eng-26)
(ORNL/TM-5700) Avail: NTIS HC A02/MF A01

Development of a time-dependent analytical model charged with a phase-change material was started. Preliminary data were obtained on the melt-freeze cycle behavior and viscosities of sodium thiosulfate pentahydrate and a mixture of Glauber's salt and borax; limited melt-freeze data were obtained on two paraffin waxes. ERA

N77-22618# Oak Ridge National Lab., Tenn.
IMPACT OF ALTERNATE FUELS ON INDUSTRIAL REFRACTORIES AND REFRACTORY INSULATION APPLICATIONS: AN ASSESSMENT
G. C. Wei and V. J. Tennery Sep. 1976 93 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5592) Avail: NTIS HC A05/MF A01

The effects of use of alternate fuels such as distillate oils, residual oils, coal, producer gas, and electricity on refractory insulation are evaluated. Sections are included on alternate fuels, assessment by industry of fuel conversion impact on industrial refractories, interactions of alternate fuel combustion products with refractories and refractory insulation, and analysis of degradation mechanisms in refractories and refractory materials. ERA

N77-22620# Brookhaven National Lab., Upton, N.Y.
HYDROGEN STORAGE, WATER ELECTROLYSIS AND FUEL CELLS FOR ELECTRIC ENERGY STORAGE
F. J. Salzano, C. Braun, A. Beaufrere, S. Srinivasan, G. Strickland, and J. J. Reilly Apr. 1976 37 p refs Presented at Symp. on Energy Storage by an Electrochem. Method: Some New Methods, Grenoble, France, 9 Apr. 1976
(Contract E(30-1)-16)
(BNL-21498; Conf-760482-1) Avail: NTIS HC A03/MF A01

The process and physical configuration, performance and costs of such a system are presented and discussed, as well as the prognosis for eventual application in a utility system. The key requirement necessary to make hydrogen production attractive for utility applications is the flexible and maximum utilization of the capital facilities required for production, storage, and where applicable, electric conversion. ERA

N77-22621# Energy Research and Development Administration, Washington, D.C. Div. of Solar Energy.
SOLAR ENERGY ENVIRONMENTAL AND RESOURCE ASSESSMENT PROGRAM Summary Report
Oct. 1976 53 p
(ERDA-76-138) Avail: NTIS HC A04/MF A01

The goals, mission, and organization of the ERA Program are presented. The four ERA program areas are: environmental assessment, technology assessment, resource assessment, and material assessment. This report defines the scope of activities within each of the above program areas. Project summaries or abstracts for all projects are included. ERA

N77-22623# Los Alamos Scientific Lab., N. Mex.
GEOTHERMAL CHEMISTRY ACTIVITIES AT LASL Progress Report, Jan. - Dec. 1975
J. Balagna, R. Charles, and R. Vidale Oct. 1976 30 p refs
(Contract W-7405-eng-36)
(LA-6448-PR) Avail: NTIS HC A03/MF A01

The nature of rock-fluid interactions was studied using both new and standard hydrothermal systems. Permeability measurements using a newly developed technique to allow measurements at elevated temperature and pressure (up to 200 C and 0.4 kb confining pressure) show granite has a minimum in situ permeability of a few tenths of a microdarcy. Noncirculating systems, rocking vessels and static vessels are used to approximate the steady state reactions found in a slow moving geothermal system. Solutions in these systems approach steady state equilibrium in a matter of hours. The sequence of mineral reactivity is quartz greater than feldspar much greater than mafic minerals for all solutions used. Solution composition reached a steady state in a few days in the temperature range 200 C to 300 C. ERA

N77-22624# Sandia Labs., Livermore, Calif.
DEVELOPMENT OF THE SOLAR POWER CENTRAL RECEIVER CONCEPT
L. M. Murphy and A. C. Skinrood Sep. 1976 26 p refs
(Contract E(29-1)-789)
(SAND-76-8677) Avail: NTIS HC A03/MF A01

The role and use of the Sandia solar thermal test facility, is described. Futhermore, details of particular subsystem components, as well as potentially fruitful research areas for Sandia and other development laboratories to pursue which can lead to performance improvements, are discussed. ERA

N77-22626# Energy Research and Development Administration, Bartlesville, Okla. Energy Research Center.
HEATING OILS, 1976
Ella Mae Shelton Aug. 1976 43 p refs
(BERC/PPS-76/4) Avail: NTIS HC A03/MF A01

Properties of 297 heating oils marketed in the United States were submitted for study and compilation. The fuels were manufactured by petroleum refining companies in domestic refineries. The data are tabulated according to six grades of fuel and subdivided into five geographic regions in which the fuels are marketed. The five regions containing a total of 16 marketing districts are shown on a map in the report. Trend charts are

included showing average properties of the six grades of fuel for the past several years. Summaries of the results of the tests by grade and by region for 1976 compared with data for 1975. ERA

N77-22627# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY AND TECHNOLOGY REVIEW
Robert W. Selden, ed., Richard B. Crawford, ed., Kent L. Cummings, ed., and Judyth K. Prono, ed. Aug. 1976 18 p refs
(Contract W-7405-eng-48)
(UCRL-52000-76-8) Avail: NTIS HC A02/MF A01

The electric gun, a versatile tool for studying initiation properties of expolsives; microcomputers and computer networks; and the preferred parts concept, which may mean that metric conversion will pay for itself by elimination of duplication, are described. Brief items also report on progress in geothermal programs, the lithium-water-air battery program, and uncertain conclusions in the study of ozone depletion. Separate abstracts are prepared for the individual articles for inclusion in the data base. ERA

N77-22629# Argonne National Lab., Ill. Solar Energy Group.
PRISMS WITH TOTAL INTERNAL REFLECTION AS SOLAR REFLECTORS
Ari Rabl May 1976 37 p refs
(Contract W-31-109-eng-38)
(ANL-SOL-76-04) Avail: NTIS HC A03/MF A01

The suitability of TIR (Total Internal Reflection) prismatic reflectors for solar energy collection is investigated systematically. ERA

N77-22630# Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Research and Development Div.
ECONOMIC FEASIBILITY: FUEL GRADE METHANOL FROM COAL
Arthur McGeorge 1976 61 p refs Sponsored by ERDA
(TID-27156) Avail: NTIS HC A04/MF A01

A plant to make fuel grade methanol from coal based on partial oxidation pressure gasifiers and low pressure methanol synthesis is described. The process is capital intensive and thus is sensitive to plant investment but relatively insensitive to coal price. The financing method is important because of the capital intensive nature of the process. Shipping and distribution costs, assuming a mix of tank wagons, tank cars, unit trains and terminals, were estimated to be about 11 cents/gal. ERA

N77-22631# Argonne National Lab., Ill.
HIGH-PERFORMANCE BATTERIES FOR OFF-PEAK ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION Progress Report, Apr. - Jun. 1976
Jul. 1976 62 p refs
(Contract W-31-109-eng-38)
(ANL-76-81) Avail: NTIS HC A04/MF A01

The present cells, which operate at 400 to 450 C, are vertically oriented, prismatic cells with a central positive electrode of FeS or FeS2, two facing negative electrodes of lithium-aluminum alloy, and an electrolyte of molten LiCl-KCl. Efforts are also under way to develop improved cell feedthroughs and electrode separators. Design work is in progress on a 30-kWh battery for a small four-passenger vehicle; this effort includes design calculations and setting specifications for the vehicle. Other battery engineering work is directed to the development of monitoring and cycling equipment and battery components. Cell chemistry studies include the wetting of materials by molten LiCl-KCl and potentiometric measurements on metal sulfide phases. Work is continuing on the development of alternative secondary cell systems. ERA

N77-22632# Battelle Pacific Northwest Labs., Richland, Wash.
USER MANUAL FOR GEOCOST: A COMPUTER MODEL FOR GEOTHERMAL COST ANALYSIS. VOLUME 2: BINARY CYCLE VERSION
H. D. Huber, R. A. Walter, and C. H. Bloomster Mar. 1976 180 p refs
(Contract E(45-1)-1830)
(BNWL-1942-V2) Avail: NTIS HC A09/MF A01

A computer model called GEOCOST was developed to simulate the production of electricity from geothermal resources and calculate the potential costs of geothermal power. GEOCOST combines resource characteristics, power recovery technology, tax rates, and financial factors into one systematic model and provides the flexibility to individually or collectively evaluate their impacts on the cost of geothermal power. Both the geothermal reservoir and power plant are simulated to model the complete energy production system. In this version of GEOCOST, geothermal fluid is supplied from wells distributed throughout a hydrothermal reservoir through insulated pipelines to a binary power plant. The power plant is simulated using a binary fluid cycle in which the geothermal fluid is passed through a series of heat exchangers. ERA

N77-22633# California Univ., Livermore. Lawrence Livermore Lab.
FIBER COMPOSITE PROGRAM FOR FLYWHEEL APPLICATIONS Quarterly Progress Report, Jan. - Mar. 1976
R. G. Stone, T. T. Chiao, J. A. Rinde, L. S. Penn, L. L. Clements, and E. Wu May 1976 12 p
(Contract W-7405-eng-48)
(UCRL-50033-76-1) Avail: NTIS HC A02/MF A01

E-glass is the cheapest of the strong, light filamentary materials and thus a promising candidate for flywheels for which cost is more critical than weight. Performance data are meager and not considered reliable. Type 30 E-glass, a 2,000-filament per strand material, is being studied because large strands minimize winding time and costs. With the very large number of filaments per strand, difficulties were encountered in proper strand wetting, void content, uneveness of filaments, and the winding process. Also the strength of the strands exceeded the capacity of the standard stress-rupture fixtures. These difficulties have been resolved, and consistent, reliable data are now being obtained. Thermal as well as stress properties have been determined. New stress-rupture fixtures have been completed and testing started. ERA

N77-22635# Sandia Labs., Albuquerque, N.Mex.
FOCUSED SOLAR COLLECTOR ANALYSIS WITH AXIALLY VARYING INPUT DUE TO SHADOWING FROM ADJACENT COLLECTORS
D. O. Lee and W. P. Schimmel, Jr. 1976 23 p refs Presented at Natl. Heat Transfer Conf., St. Louis, Mo., 8 Aug. 1976 Sponsored by ERDA
(SAND-76-5061; Conf-760816-1) Avail: NTIS HC A02/MF A01

An analytical expression for the shadowing of a collector by adjacent units as a function of collector location, spacing, and orientation is presented. Hourly variations of solar input are accounted for as are the seasonal effects of solar zenith angle. Using the shadowing expression, an axial temperature differential analysis is used to determine the output of a linear focused solar collector being shadowed by adjacent collectors. Outputs for a typical spacing configuration are presented for a north-south oriented collector field. Calculations are based on fixed tilt east-west tracking systems. The effect of the time of day on the collector output is included for the equinoxes and solstices for Albuquerque, N. M. ERA

N77-22636# Sandia Labs., Livermore, Calif. Solar Energy Technology Div.
POTENTIAL OF A SOLAR COLLECTOR WITH A STATIONARY SPHERICAL REFLECTOR AND A TRACKING ABSORBER FOR ELECTRICAL POWER PRODUCTION
A. M. Clausing (Ill. Univ., Urbana, Ill.) Aug. 1976 48 p refs
(Contract E(29-1)-789)
(SAND-76-8039) Avail: NTIS HC A03/MF A01

A fixed segment of a concave spherical mirror can be used to concentrate beam radiation onto a tracking absorber which

pivots about the center of curvature of the mirror. A possible economic advantage of this system over concentrating collectors with tracking mirrors is reduced mirror cost. The characteristics of this system are analytically studied. The strong influences of the geometrical parameters of the stationary reflector/tracking absorber system are established. The penalty caused by the fixed reflector and the influence of the absorber temperature is also determined. The daily and yearly variations in the power produced by the system are presented. ERA

N77-22637# *Energy Research and Development Administration, Washington, D.C.*
COMPARISON OF DIFFERENT WIND ENERGY CONVERSION SYSTEMS. PART 1: THE NOAH SYSTEM COMPARED WITH THE ULRICH HUTTER SYSTEM
1976 10 p refs
(Contract E(29-2)-3533)
(RFP-Trans-204-Pt-1) Avail: NTIS HC A02/MF A01

The analysis is made within the framework of structural components which are generally important for wind energy systems. Advantages and disadvantages are evaluated from technical viewpoints (type of construction, novelty, susceptibility to failure, ease of repairs, maintenance requirements), as well as in terms of expected power, performance, manufacturing cost and economy. ERA

N77-22638# Battelle Pacific Northwest Labs., Richland, Wash.
INFLUENCE OF SELECTED FEDERAL STATUTES ON ENERGY DEVELOPMENT
M. Curry and M. Greene Jun. 1976 87 p refs
(BNWL-2084(RAP-5)) Avail: NTIS HC A05/MF A01

The characteristics of the Pacific Northwest region and of the energy development/production process are described. A general overview of the Federal legislative constraints and incentives, including some discussion of their content and the implications of each piece of legislation for energy resource development; is provided. ERA

N77-22639# Energy Research and Development Administration, Washington, D.C. Div. of Solar Energy.
NATIONAL PROGRAM FOR SOLAR HEATING AND COOLING OF BUILDINGS: PROJECT DATA SUMMARIES. VOLUME 1: COMMERCIAL AND RESIDENTIAL DEMONSTRATION
Aug. 1976 170 p 3 Vol.
(Contract EG-77-C-05-5297)
(ERDA-76-127) Avail: NTIS HC A08/MF A01

The commercial demonstration program includes a wide variety of building types, such as: office buildings, schools, fire stations, civic centers, factories, libraries, etc. The residential demonstration program includes both single and multi-family dwellings. ERA

N77-22640# *Battelle Pacific Northwest Labs., Richland, Wash.*
RECOMMENDATIONS FOR A US GEOTHERMAL RESEARCH PLAN, VOLUME 1
J. B. Burnham, C. H. Bloomster, P. D. Cohn, J. R. Eliason, P. L. Peterson, C. A. Rohrmann, G. A. Sandness, D. H. Stewart, and R. W. Wallace Dec. 1975 239 p refs
(Contract NSF-C-389)
(PB-261566/4; NSF/RA/N-75-093A-Vol-1) Avail: NTIS HC A11/MF A01 CSCL 10A

The techniques used to develop plans for geothermal research are detailed. Programs and subprograms are described for each type of geothermal resource, as are recommended program budgets and time schedules. Five- and ten-year program plans in this study emphasize critical five-year milestones. GRA

N77-22641# Battelle Pacific Northwest Labs., Richland, Wash.
RECOMMENDATIONS FOR A US GEOTHERMAL RESEARCH PLAN. VOLUME 1: APPENDIX A: GLOSSARY, APPENDIX B: TASK ANALYSIS SHEETS
J. B. Burnham, C. H. Bloomster, P. D. Cohn, J. R. Eliason, P. L. Peterson, C. A. Rohrmann, G. A. Sandness, G. H. Stewart, and R. W. Wallace Dec. 1975 425 p
(Contract NSF C-389)
(PB-261567/2; NSF/RA/N-75-093B-Vol-1-App-A; NSF/RA/N-75-093B-Vol-1-App-B) Avail: NTIS HC A18/MF A01 CSCL 10A

A comprehensive project-oriented plan has been developed to best meet the national objectives in geothermal research, to be performed during the next ten years. GRA

N77-22642# Battelle Pacific Northwest Labs., Richland, Wash.
RECOMMENDATIONS FOR A US GEOTHERMAL RESEARCH PLAN. VOLUME 2: EXECUTIVE SUMMARY
J. B. Burnham, C. H. Bloomster, P. D. Cohn, J. R. Eliason, P. L. Peterson, C. A. Rohrmann, G. A. Sandness, D. H. Stewart, and R. W. Wallace Dec. 1975 64 p refs
(Contract NSF C-389)
(PB-261568/0; NSF/RA/N-75-093-Vol-2) Avail: NTIS HC A04/MF A01; also avail. in set of 3 reports as PC E11, PB-261565-SET CSCL 10A

A comprehensive, project-oriented plan was developed to best meet the national objectives in geothermal research to be performed during the next ten years. Necessary projects and tasks are defined under each of the subprograms such that each geothermal resource can become economically viable within a ten-year period. Recommended five-year budgets are selected on the basis of the allocations model. GRA

N77-22643# Battelle Pacific Northwest Labs., Richland, Wash.
RECOMMENDATIONS FOR A GEOTHERMAL UTILIZATION PLAN, VOLUME 3
J. B. Burnham, C. H. Bloomster, P. D. Cohn, J. R. Eliason, P. L. Peterson, C. A. Rohrmann, G. A. Sandness, D. H. Stewart, and R. W. Wallace Dec. 1975 20 p
(Contract NSF C-839)
(PB-261569/8; NSF/RA/N-75-093C-Vol-3) Avail: NTIS HC A02/MF A01; also avail. in set of 4 reports PC E11, PB-261565 SET CSCL 10A

Volume III, describes the general principles used in the design of the utilization projects, and discusses the details of these projects and tasks as developed under each of the various resources. GRA

N77-22644# Battelle Columbus Labs., Ohio.
ENERGY USE PATTERNS IN METALLURGICAL AND NONMETALLIC MINERAL PROCESSING (VOLUME 1, PHASE 6: ENERGY DATA AND FLOW SHEETS, LOW-PRIORITY COMMODITIES) Final Report
21 Jul. 1976 275 p refs
(Contract DI-BM-SO-144093)
(PB-261150/7; BM-OFR-117-76-Vol-1) Avail: NTIS HC A13/MF A01 CSCL 08I

Descriptions are given of mineral processing, flow sheets, and energy content for each stage of processing for 43 low-priority commodities (on the basis of volume produced and total energy content) including 33 minor metals such as bismuth, cadmium, gold, and hafnium, and 10 nonmetallic products such as gem stones, graphite, bauxite, iodine, and crushed and sized stones. GRA

N77-22645# Battelle Columbus Labs., Ohio.
ENERGY USE PATTERNS IN METALLURGICAL AND NONMETTALIC MINERAL PROCESSING (VOLUME 1, PHASE 9: AREAS WHERE ALTERNATIVE TECHNOLOGIES SHOULD BE DEVELOPED TO LOWER ENERGY USE IN PRODUCTION OF HIGH-PRIORITY COMMODITIES), SUPPLEMENT Final Report
25 Aug. 1976 76 p refs
(Contract DI-BM-SO-144093)
(PB-261153/1; BM-OFR-117-76-Vol-1-Suppl) Avail: NTIS HC A05/MF A01 CSCL 08I

An analysis is given of areas where alternative technologies should be developed to reduce energy required in the production of 14 high-volume commodities. Primary attention is given to aluminum, lime, cement, common brick, copper, glass, iron and steel slabs and castings, lead, nitrogen-ammonia, phosphorus-

phosphoric acid, basic and fireclay refractories, sulfuric acid, and zinc. GRA

N77-22646# Shell Oil Co., Houston, Tex. Mining Ventures Dept.
EVALUATION OF COMBINED IN-SITU AND SURFACE RETORTING OF OIL SHALE TRACT C-b
A. P. Grossman Nov. 1976 33 p refs
(Contract DI-14-09-0070-653)
(PB-261064/0; B-OFR-116-76) Avail: NTIS HC A03/MF A01 CSCL 08I

A case for modified in-situ oil shale retorting process is discussed in combination with surface retorting of higher grade shales. Examples and costs are given for an oil shale tract. GRA

N77-22649# Federal Energy Administration, Washington, D. C. Office of the Administrator.
REPORT OF THE PRESIDENTIAL TASK FORCE ON REFORM OF FEDERAL ENERGY ADMINISTRATION REGULATIONS, VOLUME 1
Dec. 1976 236 p refs Prepared in cooperation with the Council of Economic Advisors
(PB-262181/1; FEA/T-77/018) Avail: NTIS HC A11/MF A01 CSCL 10A

Results from a Presidential decision, in February 1976, to create independent task forces comprised of qualified personnel from other departments and agencies to assist certain Federal regulatory agencies in evaluating their regulations are reported. The issues discussed are: (1) simplifications or improvements in FEA price and allocation regulations, including regulations for FEA's mandatory oil import program; and (2) improvements in FEA procedures for developing, promulgating, and implementing regulations. GRA

N77-22650# Federal Energy Administration, Washington, D. C. Office of the Administrator.
REPORT OF THE PRESIDENTIAL TASK FORCE ON REFORM OF FEDERAL ENERGY ADMINISTRATION REGULATIONS, VOLUME 2. TABLE OF CONTENTS. APPENDIXES
Dec. 1976 193 p Prepared in cooperation with the Council of Economic Advisors
(PB-262182/9; FEA/T-77/019) Avail: NTIS HC A09/MF A01 CSCL 10A

The table of contents and appendices to the report of the Presidential Task Force on Reform of Federal Energy Administration Regulations, Volume 1 is given. GRA

N77-22652# Lear Motors Corp., Reno, Nev.
GEOTHERMAL HOT WATER PUMP, APPENDIX
1976 115 p refs
(Grant NSF AER-74-18753)
(PB-262030/0; LMC-760504-A-App; NSF/RA-760380) Avail: NTIS HC A06/MF A01 CSCL 08I

A hot water pumping system for use in geothermal reservoirs was developed. The system consists of a high speed electric motor driven submersible pump which can operate at depths of 1,000 feet or more, and at temperatures up to (232C). Six appendixes are presented in this report: (1) generator computer analysis; (2) power transmission cable vendor data; (3) electric motor computer analysis; (4) motor electrical insulation vendor data; (5) electromagnetic material vendor data; and (6) motor test procedure. GRA

N77-22653# Systems Science and Software, La Jolla, Calif.
GEOHYDROLOGICAL ENVIRONMENTAL EFFECTS OF GEOTHERMAL POWER PRODUCTION, PHASE 2A Final Report, 1 Jun. 1975 - 1 Jun. 1976
J. W. Pritchett, S. K. Garg, D. H. Brownell, Jr., L. F. Rice, and M. H. Rice Sep. 1976 188 p refs
(Grant NSF AER-75-14492)
(PB-261687/8; SSS-R-77-2998; NSF/RA-760317) Avail: NTIS HC A09/MF A01 CSCL 08I

A fully active geothermal reservoir simulator for simultaneous treatment of fluid flow and ground movement effects was developed. Application of the reservoir simulator to a two-dimensional vertical model of the Wairakei geothermal system has successfully reproduced the total fluid production history. GRA

N77-22654# Texas Univ., Dallas. Richardson Inst. for Geosciences.
THERMAL CONDUCTIVITY MEASUREMENT AND PREDICTION FROM GEOPHYSICAL WELL LOG PARAMETERS WITH BOREHOLE APPLICATION
Ronald Gross and Jim Combs 1976 35 p refs
(Grants NSF GI-36250; NSF AER-72-03551)
(PB-262372/6; NSF/RA-760364; Contrib-291) Avail: NTIS HC A03/MF A01 CSCL 08I

Measurements on each of 50 samples were made for thermal conductivity, bulk density, porosity, permeability, electrical resistivity and conductivity, compressional and shear velocity, and free fluid index. These physical properties were analyzed to derive predictive equations for thermal conductivity. Application of these relationships to thoroughly investigated geothermal borehole sections indicates that prediction from standard geophysical well logs may be more reliable than cell measurements in determining the thermal conductivity of unconsolidated sedimentary sequences. GRA

N77-22656# Office of Naval Research, London (England).
THE 10TH INTERNATIONAL POWER SOURCES SYMPOSIUM
W. G. Soper 21 Oct. 1976 14 p refs Symp. held at Brighton, Engl., 13-16 Sep. 1976
(AD-A033323; ONRL-C-30-76) Avail: NTIS HC A02/MF A01 CSCL 10/1

A summary is given of the 10th International Power Sources Symposium at which 48 papers were presented. Emphasis in the review is placed upon secondary batteries with high energy density, i.e., those most suitable for electrically powered vehicles. An introductory discussion of the principles of batteries and measures of performance is also included. Author (GRA)

N77-22657# Kansas Univ. Center for Research, Inc., Lawrence.
ASSESSMENT OF FUEL-CONSERVATION POTENTIAL OF A GROUND-TRANSPORTATION SYSTEM DUE TO FULL UTILIZATION OF ITS MASS TRANSPORTATION CAPABILITIES Final Report
Joe Lee Jan. 1977 134 p refs
(Grant NSF KO-42151)
(PB-262125/8; CRINC-2620-01) Avail: NTIS HC A07/MF A01 CSCL 13B

The approach is experimental rather than theoretical. A selected city, in this case Kansas City, Kansas was evaluated. The specific works include the estimation of existing excessive mass transit capacity, the auto trips that potentially can be diverted to use mass transit, and the fuel savings due to such diversions. Results have an acceptable accuracy, and the procedures developed are useful for assessing fuel saving capability of a ground transportation system under an emergency situation. A manual describing the general use of the developed procedures is included. GRA

N77-22659# Energy Resources Co., Inc., Cambridge, Mass.
ENVIRONMENTAL RESEARCH NEEDS FOR COAL CONVERSION AND COMBUSTION TECHNOLOGIES Final Report
John Ehrenfeld, Barry Gehron, Miriam Goldberg, John Gushue, and Ben Ross Dec. 1976 307 p refs
(Contract EQ6AC007)
(PB-262159/7; EQ-517613007) Avail: NTIS HC A14/MF A01 CSCL 21D

Coal combustion technology in the econmy is investigated. This aim stresses current and near-term understanding of sources, effects and consequences, rather than ultimate fundamental knowledge of all of the causal mechanisms leading to the generation, transport, control and effects of pollutants. GRA

N77-22666# Naval Postgraduate School, Monterey, Calif.
AN OPTIMIZATION STUDY OF A LOW THERMAL POTENTIAL POWER SYSTEM Final Report
J. R. Buckingham, W. M. Raike, and M. D. Kelleher Sep. 1976 111 p refs
(AD-A031709; NPS-69Kk76091) Avail: NTIS HC A06/MF A01 CSCL 10/2

A power generating system using the low thermal potential available from the vertical temperature distribution of the ocean is analyzed as a combined engineering and economic mathematical model. The model is optimized for minimum capital cost employing a sequential unconstrained minimization algorithm. Examples of the kinds of engineering and cost information available from the model are presented. Author (GRA)

N77-22667# RAND Corp., Santa Monica, Calif.
CALIFORNIA'S ENERGY FUTURE
Deane N. Morris Mar. 1976 31 p
(AD-A032221; P-5616) Avail: NTIS HC A03/MF A01 CSCL 10/1

This paper presents an abridgement of the results of a Rand study on energy policy issues facing California, more fully reported in Energy Alternatives for California: Paths to the Future, R-1793-CSA/RF, and summarized in some detail in an Executive Summary, R-1793/1-CSA/RF. The study is concerned with the problems of an uncertain future. These problems are extraordinarily complex and interwoven. Under conditions of rapid change, the full consequences of policy actions are difficult to predict and policy objectives are difficult to define. In addition, the relationships between state and federal actions are poorly understood, involving issues of equity among individuals and regions, and issues of environment, health, safety, and land use. Simple solutions should not be expected in such a policy area. However, a number of recommendations are presented because policy decisions should be made on the basis of the best information available when the political process demands they be made. The brief summary presented here necessarily omits most of the rationale for our conclusions and recommendations, as well as a number of subsidiary conclusions. The interested reader should consult the full report for these additional details. Author (GRA)

N77-22668# KVB Engineering, Inc., Tustin, Calif.
CONTROL OF OXIDES OF SULFUR FROM STATIONARY SOURCES IN THE SOUTH COAST AIR BASIN OF CALIFORNIA Final Report, Jun. 1975 - Jun. 1976
S. C. Hunter and N. L. Helgeson Jun. 1976 341 p refs
(Contract ARB-4-421)
(PB-261754/6; KVB-5802-432; ARB-R-4-421-76-53) Avail: NTIS HC A15/MF A01 CSCL 13B

An inventory of oxides of sulfur (SOx) emissions from stationary sources in the South Coast Air Basin of California was compiled for 1974. Emissions from over 1,580 point sources were assessed from device and fuel use information provided by the device operators and local air pollution control districts. Sulfur oxide emissions were estimated to be 342 tons per day on an annual average basis in 1974. Power plants were the dominant source category, followed by refineries, carbon plants, and a variety of smaller sources. Some emission tests were conducted to verify the inventory. Forecasts made to 1980 indicate substantial increases over 1974 emissions as the result of increased fuel oil burning. GRA

N77-22669# National Bureau of Standards, Washington, D. C. Center for Building Technology.
INTERIM PERFORMANCE CRITERIA FOR SOLAR HEATING AND COOLING SYSTEMS IN COMMERCIAL BUILDINGS
Nov. 1976 102 p
(Contract E(49-1)-3800)
(PB-262114/2; NBSIR-76-1187) Avail: NTIS HC A06/MF A01 CSCL 13A

These interim criteria have the following objectives: (1) to provide designers, manufacturers and evaluators with the technical performance criteria that will be used for the commercial solar heating and cooling demonstration program; (2) to establish technical performance levels that will be used for evaluation and procurement of systems, subsystems and components for the commercial solar heating and cooling demonstration program; and (3) to provide a basis for the development of more definitive performance criteria at a later date. GRA

N77-22670# Simulation Physics, Inc., Burlington, Mass.
SILICON THIN FILM CRYSTALLIZATION AND SOLAR CELL FABRICATION Quarterly Progress Report, Jun. - Sep. 1976
A. R. Kirkpatrick, T. P. Shaughnessy, and M. Oren Oct. 1976 82 p refs
(Grant NSF AER-76-06096)
(PB-261715/7; QR-10045-2; QPR-2; NSF/RA-760333) Avail: NTIS HC A05/MF A01 CSCL 10B

First, the feasibility of fabricating high efficiency solar cells from thin films using a novel technique, electrostatic bonding, and transferring the film from a temporary growth substrate to glass encapsulating superstrate, is demonstrated. This is the key program task since the fabrication technology developed can be applied to a wide range of film types and deposition procedures. The second program task, the recrystallization of thin-film silicon, also involves an innovative approach. This approach is based upon the use of high-efficiency directed energy sources to raise thin films to high recrystallization temperatures without substrate heating. GRA

N77-22671# Washington Univ., Seattle. Inst. for Environmental Studies.
ELECTRIC POWER DEVELOPMENT IN THE PACIFIC NORTHWEST REGION: INSTITUTIONAL COMMITMENTS AND ALTERNATIVES, PHASE 1 Interim Report
Kai N. Lee, Marion E. Marts, Robert G. Walton, and Alison D. Birmingham 1 Sep. 1976 167 p refs
(Contract DI-14-34-0001-6050)
(PB-262382/5; W77-03288; OWRT-A-080-WASH (1)) Avail: NTIS HC A08/MF A01 CSCL 10B

Pacific Northwest regional electric power development was studied with three objectives: (1) to assemble an historical account of institutional arrangements for electric power development in the region, (2) to identify emergent public policy issues; and (3) to identify long-range institutional research and problems relevent to regional energy and resources development. GRA

N77-22672# American Cyanamid Co., Stamford, Conn. Chemical Research Div.
CADMIUM STANNATE SELECTIVE OPTICAL FILMS FOR SOLAR ENERGY APPLICATIONS Final Report, 1 Jul. 1973 - 31 Aug. 1976
G. Haacke and L. C. Burton (Del. Univ., Newark) Sep. 1976 70 p refs
(Grant NSF AER-73-07957)
(PB-261850/2; NSF/RA-760309) Avail: NTIS HC A04/MF A01 CSCL 10B

The development of cadmium stannate coatings for utilization in solar energy converters is reviewed and evaluated. GRA

N77-22673# Department of Health, Education, and Welfare, Washington, D.C. Office of Consumer Affairs.
BUYING SOLAR
Joe Dawson Jun. 1976 81 p refs
(PB-262134/0; FEA/G-76/154) Avail: NTIS HC A05/MF A01 CSCL 13A

Guidelines for the consumer interested in buying a solar system are provided to help the homeowner considering the use of solar energy for space heating and cooling, and domestic water heating. The guidelines also help the consumer to make informed decisions based on geographic location, type of home, quality of insulation, present energy costs, and type of solar system intended for purchase. Engineering terms used to evaluate or describe solar products are also included. GRA

N77-22674# Energy Resources Council, Washington, D. C.
PERSPECTIVE ON ENERGY POLICY
Elliot L. Richardson and Frank G. Zarb 16 Dec. 1976 119 p
Sponsored by Federal Energy Admin.

(PB-261736/3; FEA/T-76/514) Avail: NTIS HC A06/MF A01 CSCL 21D

This is an overview of areas where accomplishments have been made, areas where changes are needed, and initiatives which should be analyzed in greater depth. The following issues are discussed: energy situations, Federal regulatory policy, energy conservation, energy development, electric utility regulatory reform, nuclear energy, energy financing, energy R&D priorities, international considerations and Federal energy organization. GRA

N77-22675# Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.

STRATEGIC PETROLEUM RESERVE. FINAL ENVIRONMENTAL IMPACT STATEMENT, VOLUME 1

Dec. 1976 583 p refs 2 Vol.

(PB-261799/1; FEA/S-76/487-Vol-1; FES-76/2-Vol-1) Avail: NTIS HC A25/MF A01 CSCL 21D

It is proposed that crude oil be stored underground in solution-mined salt cavities and in conventional mines. However, modification to the proposal may require that petroleum products be stored aboveground in tanks. This programmatic EIS (Environmetal Impact Statement) identified particularly sensitive environmental parameters that are being investigated in more detail in specific EIS's for each candidate site. GRA

N77-22676# Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.

STRATEGIC PETROLEUM RESERVE. FINAL ENVIRONMENTAL IMPACT STATEMENT, VOLUME 2

Dec. 1976 273 p refs 2 Vol.

(PB-261800/7; FEA/S-76/488-Vol-2; FES-76/2-Vol-2) Avail: NTIS HC A12/MF A01 CSCL 21D

Comments on the programmatic environmental impact statement (Volume 1) from federal, state, and local agencies and private industry concerning storage of crude oil underground in solution--mined salt cavities and in conventional mines are presented. GRA

N77-22677# Federal Energy Administration, Washington, D. C. Office of Energy Resources Development.

ELECTRIC UTILITY FINANCE WORKSHOP

Jul. 1976 31 p Proceedings held at Washington, D. C., 20 Jul. 1976

(PB-261661/3; FEA/G-76/496) Avail: NTIS HC A03/MF A01 CSCL 10A

Contents: National policy on need for new electric generating capacity; national policy on fuel choice; areas of innovation; possible federal initiatives with respect to electric utilities. GRA

N77-22678# Alaska Univ., College. Geophysical Inst.

GEOTHERMAL ENERGY AND WIND POWER: ALTERNATE ENERGY SOURCES FOR ALASKA

R. B. Forbes, ed. Apr. 1976 256 p refs Conf. Proc. of the Alaskan Geothermal and Wind Power Resources Planning Conf., Anchorage, Alaska, 8-9 Jul. 1975 Prepared in cooperation with the Alaska Energy Office, Juneau

(Grant NSF AER-75-20207)

(PB-261521/9; NSF/RA-760246) Avail: NTIS HC A12/MF A01 CSCL 10A

The Alaskan energy problems that can be alleviated through wind and geothermal resources are defined, and recommended plans for the initiation of state and federal programs are presented. Working groups were formed in the following areas: agriculture, electrical power, fisheries and agriculture, geothermal resource research and development, space heating and industrial application, and wind power development and applications. GRA

N77-22679# General Electric Co., Washington, D.C. Center for Energy Systems.

ENERGY INPUT-OUTPUT MODELLING: PROBLEMS AND PROSPECTS Final Report

James M. Griffin Nov. 1976 123 p refs Sponsored by Electric Power Research Inst.

(PB-261925/2; EPRI-EA-298) Avail: NTIS HC A06/MF A01 CSCL 10A

The methodological differences and empirical justification for the use of physical energy I-O coefficients, which rely on real dollar flows were investigated. Energy-oriented applications of I-O analysis were reviewed. These include applications based on physical and on real dollar flows. These studies range from static energy I-O coefficient analysis of the Btu content of an auto to efforts to dynamize I-O models by allowing the coefficients to change in response to relative prices and technology. GRA

N77-22680# Geonomics, Inc., Berkeley, Calif.

GEOTECHNICAL ENVIRONMENTAL ASPECTS OF GEOTHERMAL POWER GENERATION HEBER, IMPERIAL VALLEY, CALIFORNIA Topical Report, no. 1

Oct. 1976 100 p refs Sponsored by Electric Power Research Inst.

(PB-260848/7; EPRI-ER-299) Avail: NTIS HC A05/MF A01 CSCL 10B

The feasibility of constructing a 25 to 50 MWe geothermal power plant using low salinity hydrothermal fluid as the energy source was assessed. The geotechnical aspects of geothermal power generation and their relationship to environmental impacts in the Imperial Valley of California were investigated. Geology, geophysics, hydrogeology, seismicity and subsidence in terms of the availability of data, state-of-the-art analytical techniques, historical and technical background and interpretation of current data are discussed GRA

N77-22683# Hawaii Univ., Honolulu. Dept. of Mechanical Engineering.

CONCEPTUAL DESIGN OF A 10MW REGENERATIVE ISOBUTANE GEOTHERMAL POWER PLANT

Ashok K. Gupta and James L. S. Chou 15 Oct. 1976 81 p refs

(Contract E(04-3)-1093; Grant NSF GI-38319)

(PB-261563/1; HGP-TR-18; NSF/RA-760377) Avail: NTIS HC A05/MF A01 CSCL 10B

The regenerative binary cycle, as applied to the geothermal brines for the generation of power, is evaluated. To improve the thermal efficiency of the basic cycle, a regenerative heat exchanger is used to transfer the heat from the turbine exhaust to the compressed isobutane entering the main heat exchanger. This results in reducing the size of the condenser, cooling equipment, and the main heat exchanger. Another effect is the increase of the temperature of the waste brine so that the waste heat could be utilized effectively. GRA

N77-22684# Hawaii Univ., Honolulu. Dept. of Mechanical Engineering.

WORKING FLUID SELECTION AND PRELIMINARY HEAT EXCHANGER DESIGN FOR A RANKINE CYCLE GEOTHERMAL POWER PLANT

Deane H. Kihara and Paul S. Fukunaga 1976 30 p refs Presented at 2d United Nations Symp. on the Develop. and Use of Geothermal Resources, San Francisco, 20-29 May 1975

(Contract E(04-3)-1093; Grant NSF GI-38319)

(PB-261564/9; HGP-TR-20; NSF/RA-760378) Avail: NTIS HC A03/MF A01 CSCL 10B

A list of possible working fluids with wide ranges of property values is examined, and two, isobutane and R-114, are selected as being representative of the type of working fluid that might be selected by plant engineers. Heat exchangers will be at the interface between the geothermal fluid and the working fluid and will constitute an essential component of this particular means of energy conversion. A parametric study is conducted of a vertical, counterflow, shell and tube heat exchanger designed for use in a 10 MW geothermal power plant which utilizes geothermal brine at moderate temperatures. The computational procedure for determining the required brine flow rate, tube lengths, number of tubes, and pressure drops is outlined. GRA

N77-22685# Hawaii Inst. of Geophysics, Honolulu.
A COORDINATED EXPLORATION PROGRAM FOR GEOTHERMAL SOURCES ON THE ISLAND OF HAWAII Progress Report, May 1973 - Apr. 1975
Augustine S. Furumoto 30 Apr. 1975 35 p refs
(Grant NSF GI-38319)
(PB-261691/0; HIG-Contrib-673; NSF/RA/N-75-348) Avail: NTIS HC A03/MF A01 CSCL 08I

Infrared scanning surveys by aircraft followed by reconnaissance-type electrical surveys and ground noise surveys narrowed down the promising area to the east rift of Kilauea. The surveys carried out over the east rift included magnetic, gravity, and electrical surveys by various methods; microearthquake surveillance; temperature profiling of wells; and chemical analysis of water samples. Aeromagnetic, regional gravity, and crustal seismic refraction data were available in the published literature. A model of the thermal structure of the east rift was put together to account for the data. The dike complex through which magma from the central vent of Kilauea travels laterally occupies a zone 3 km wide extending from 1 km to 5 km depth. On the south side of the dike complex, there may be a self-sealing geothermal reservoir where groundwater heated by the dike complex is trapped. Not all of the dike complex is hot; hot sections seem to occur in patches. GRA

N77-22686# Mathematica, Inc., Philadelphia, Pa. Div. of Energy.
SOURCES OF ENERGY DATA FOR ILLINOIS Final Report
Jeffrey P. Price and Janet S. Farr Aug. 1976 390 p Sponsored by the Ill. Dept. of Business and Economic Development, Springfield
(PB-262562/2; ILLDOE-76/01) Avail: NTIS HC A17/MF A01 CSCL 10A

A compendium of Illinois statistical data sources and an assessment of their important characteristics is presented. The data sources are generated from institutions both within Illinois and elsewhere in the country. The types of data identified are statistical data relating to Illinois energy demand and end use, supply, flow, prices, facilities, processing, exploration, production, and resources, as well as related demographic, economic, and environmental data. GRA

N77-22687# Texaco, Inc., El Monte, Calif. Montebello Research Lab.
HYDROGEN PRODUCTION FROM COAL LIQUEFACTION RESIDUES Final Report
Allen M. Robin Dec. 1976 72 p
(PB-261734/8; EPRI-AF-233) Avail: NTIS HC A04/MF A01 CSCL 07A

High ash H-coal residues from the liquefaction of Illinois No. 6 and Wyodak coals were gasified. The synthesis gas produced consisted of over 92 volume percent carbon monoxide (CO) and hydrogen (H2) on a dry basis. Approximately 40 tons of each residue was gasified at 24 atmospheres pressure at residue feed rates up to 1/2 ton per hour. No major operating problems were experienced. Cold gas efficiencies averaged between 83 and 84 percent. Steam and oxygen requirements were comparable to those of heavy oil gasification. GRA

N77-22688# Martin Marietta Labs., Baltimore, Md.
BIOLOGICAL SOLAR ENERGY CONVERSON: APPROACHES TO OVERCOME YIELD, STABILITY AND PRODUCT LIMITATIONS Progress Report, 1 Apr. - 30 Sep. 1976
Bessel Kok, C. F. Fowler, H. H. Hardt, and R. J. Radmer 1976 42 p refs
(Grant NSF AER-73-03291)
(PB-261910/4; MML-TR-76-16c; NSF/RA-760313; PR-3) Avail: NTIS HC A03/MF A01 CSCL 06A

The rate inhibition induced by treating chloroplasts with glutaraldehyde is studied. The decay of activity of isolated chloroplasts stored in the dark is studied as a function of pH. The program concerning the size of the photosynthetic unit in relation to the utilization of high light includes studies of nitrogen-starved algae and the possible role of carotenoids which accumulate in these cells. No specific photochemical process driven by carotenoids in these organisms was detected. Comparative studies of the light gathering systems in the bundle sheath and mesophyll cells of C4 plants are initiated. GRA

N77-22700# Research Triangle Inst., Research Triangle Park, N.C.
TECHNOLOGY AND ECONOMICS OF FLUE GAS NOx OXIDATION BY OZONE Final Report, Jul. - Oct. 1976
J. W. Harrison Dec. 1976 74 p refs
(Contract EPA-68-02-1325)
(PB-261917/9; EPA-600/7-76-033) Avail: NTIS HC A04/MF A01 CSCL 13B

Stationary combustion sources contribute about half the manmade NOx emitted to the atmosphere in the U.S. Flue gas from combustion processes contains NOx which is predominantly in the form of NO. Although NO2 is to some extent soluble in water or aqueous solutions, NO is practically insoluble when conventional scrubbing processes are used. For effective removal, the NO must either be reduced to elemental nitrogen or oxidized to NO2 or higher oxides which can be removed by scrubbing. GRA

N77-22705# Institute of Gas Technology, Chicago, Ill.
INITIAL ENVIRONMENTAL TEST PLAN FOR SOURCE ASSESSMENT OF COAL GASIFICATION Final Report, Jun. 1973 - Dec. 1974
A. Attari, M. Mensinger, and J. Pau Sep. 1976 146 p refs
(Contract EPA-68-02-1307)
(PB-261916/1; EPA-600/2-76-259) Avail: NTIS HC A07/MF A01 CSCL 13B

A source assessment environmental test plan, developed to investigate the fate of various constituents during coal gasification is described. The plan is an approach to the problems associated with sampling point selection, sample collection, and sample analysis which is based on a HYGAS-type process. GRA

N77-22709# *Tennessee Univ., Knoxville. Water Resources* Research Center.
THERMAL EFFECTS ON BIODEGRADATION OF POLLUTANTS IN WATER
C. George Hollis 3 Dec. 1976 32 p refs Sponsored by Office of Water Res. and Technol. Prepared in cooperation with Memphis State Univ., Tenn.
(PB-261512/8; W77-02218; OWRT-A-037-TENN(1); RR-53) Avail: NTIS HC A03/MF A01 CSCL 13B

Biodegradation was enhanced by acclimatizing the sewage seed to LAS (Linear Alkyl Sulfonate) when compared to using unacclimatized seed and seed acclimatized to temperature only. Carbon chain degradation, sulfate removal and benzene ring opening of the LAS molecule were somewhat simultaneous and were influenced by incubation temperatures. The presence of glucose in the reaction mixture retarded the rate of LAS carbon chain biodegradation. The data suggest thermal pollution would increase the rate by which trace amounts of biodegradable organic compounds, such as LAS, would be degraded in water. GRA

N77-22725# Energy Research and Development Administration, Bartlesville, Okla. Bartlesville Energy Research Center.
FUEL CONSUMPTION, EMISSIONS, AND POWER CHARACTERISTICS OF THE 1975 FORD 140-CID AUTOMOTIVE ENGINE, EXPERIMENTAL DATA Interim Report, Feb. - Apr. 1976
W. F. Marshall and K. R. Stamper Nov. 1976 42 p
(Contract DOT-TSC-RA-75-10)
(PB-261771/0; BERC/OP-76/15; DOT-TSC-OST-76-43) Avail: NTIS HC A03/MF A01 CSCL 21G

Experimental data were obtained in dynamometer tests of the 2-bbl engine to determine steady-state fuel consumption and emissions of hydrocarbon, carbon monoxide, and oxides of nitrogen. These data were obtained in detail adequate to construct performance maps for the entire speed/load operating range of the engine. GRA

N77-22732# Bureau of Mines, Washington, D.C.
SIZE DISTRIBUTION AND MASS OUTPUT OF PARTICULATES FROM DIESEL ENGINE EXHAUSTS Report of investigations 1976
John A. Breslin, Anthony J. Strazisar, and Richard L. Stein Oct. 1976 16 p refs
(PB-261416/2; BM-RI-8141R) Avail: NTIS HC A02/MF A01 CSCL 13B

Samples were taken from the exhaust of two types of engines using three types of fuel. The measured mass median diameters of the diesel particulates were typically about 0.3 micrometer. Concentration measurements ranged from 14.2 to 250.9 mg/cu m and calculated mass outputs from 64 to 10,000 mg/min. Significant differences in mass output were found between engines, fuels, and especially between different operating modes. The quantity of clean dilution air which would be required to reduce the particulate mass concentration below the 2.0 mg/cu m respirable dust standard for coal mines was greater than the dilution air required to meet the standards for noxious gases for both engines tested. GRA

N77-22741*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLICATIONS OF AEROSPACE TECHNOLOGY TO PETROLEUM EXPLORATION. VOLUME 1: EFFORTS AND RESULTS
Leonard D. Jaffe 30 Sep. 1976 145 p refs 2 Vol.
(Contract NAS7-100)
(NASA-CR-152694; JPL-Doc-5040-32-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 08G

The feasibility of applying aerospace techniques to help solve significant problems in petroleum exploration is studied. Through contacts with petroleum industry and petroleum service industry, important petroleum exploration problems were identified. For each problem, areas of aerospace technology that might aid in its solution were also identified where possible. Topics selected for investigation include: seismic reflection systems; down-hole acoustic techniques; identification of geological analogies; drilling methods; remote geological sensing; and sea floor imaging and mapping. Specific areas of aerospace technology are applied to 21 concepts formulated from the topics of concern. Author

N77-22742*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLICATIONS OF AEROSPACE TECHNOLOGY TO PETROLEUM EXPLORATION. VOLUME 2: APPENDICES
Leonard D. Jaffe 30 Sep. 1976 296 p refs 2 Vol.
(Contract NAS7-100)
(NASA-CR-152693; JPL-Doc-5040-32-Vol-2) Avail: NTIS HC A13/MF A01 CSCL 08G

Participants in the investigation of problem areas in oil exploration are listed and the data acquisition methods used to determine categories to be studied are described. Specific aerospace techniques applicable to the tasks identified are explained and their costs evaluated. A.R.H.

N77-22750# California Univ., Berkeley. Dept. of Materials Science and Engineering.
USE OF ELECTRICAL METHODS FOR THE DELINEATION OF GEOTHERMAL RESERVOIRS Final Report
F. Morrison Sep. 1975 40 p
(Grant NSF GI-37905)
(PB-261507/8; NSF/RA/N-75-336) Avail: NTIS HC A03/MF A01 CSCL 08G

Two areas in Nevada (Buffalo Valley and Beowawe) were selected because they represented typical geothermal areas of the central basin and range province, and afforded easy access for geophysical surveys. A brief description of the electrical methods used is presented in this study. Details of some of the equipment developed are included as appendixes. Results of the research indicate the importance of using some form of reconnaissance mapping. The simple E-field ratio technique is effective and compares favorably with the bipole-dipole resistivity mapping technique at less expense. GRA

N77-22775# Northwestern Univ., Evanston, Ill. Dept. of Civil Engineering.
STOCHASTIC MODELLING OF SITE WIND CHARACTERISTICS Final Report, Jan. 1975 - Sep. 1976
Ross B. Corotis Nov. 1976 311 p refs Sponsored in part by ERDA
(PB-261178/8; ERDA/NSF-00357/76/1) Avail: NTIS HC A14/MF A01 CSCL 04B

Statistical methods and probability models are used to determine optimal evaluation procedures for survey data. Several years of hourly records from six Midwest sites and one Rocky Mountain site provide a data base to develop the models and procedures. GRA

N77-22967# California Univ., Livermore. Lawrence Livermore Lab.
FIELD-REVERSED MIRROR AS A D-T POWER REACTOR
W. C. Condit 24 Sep. 1976 14 p refs Presented at 2nd ANS Topical Meeting on the Technology of Controlled Nucl. Fusion, Richland, Wash., 21 Sep. 1976
(Contract W-7405-eng-48)
(UCRL-78082; Conf-960935-7) Avail: NTIS HC A02/MF A01

The Field-Reversed-Mirror is a plasma confinement scheme which uses the diamagnetic current of the D-T fuel plasma to convert the open field pattern of a conventional mirror machine into a closed-field pattern with plasma confinement properties which are expected to be considerably improved. If realized, this improvement in confinement will considerably improve the energy gain of the mirror reactor, and result in a reduction in the cost of producting energy. The Field Reversed Mirror device is described and compared with earlier field-reversed configurations, and the overall energy and particle balance relations are given. Based on this, preliminary engineering design calculations of the major components of an FRM reactor are presented. A cost optimization performed, and the optimum DT reactor is found to have a fusion output of 23 MW/cell from a plasma radius 5 cm, length 15 cm, in a field of roughly 10 Tesla. ERA

N77-22968# General Atomic Co., San Diego, Calif.
DESIGN CONSIDERATIONS FOR A NONCIRCULAR TOKAMAK DEMONSTRATION PLANT
D. Kearney, R. Bourque, W. Chen, J. Dalessandro, R. Hager, B. McHarg, M. Mintz, S. Rosenwasser, K. R. Schultz, and R. Thomas 20 Aug. 1976 14 p refs Presented at the 2d ANS Topical Meeting on the Technol. of Controlled Nuclear Fusion, Richland, Washington, 21-23 Sep. 1976
(Contract E(04-3)-0167)
(GA-A-14074) Avail: NTIS HC A02/MF A01

Design studies were carried out to identify and evaluate technological problems and examine alternatives for an initial conceptual design of a noncircular Tokamak demonstration power reactor. It was shown that a demonstration power plant can exhibit high net efficiency, a tritium breeding ratio greater than or equal to 1, and can provide the basis for technological and economic scaling to commercial plants. The emphasis was to examine areas unique to noncircular Tokamaks. The important systems and technological tradeoffs made to arrive at a consistent, feasible reactor design are discussed along with commercial plant requirements, the low-exposure maintenance concept, the tritium handling system, the flowing plasma boundary impurity control, the field-shaping coil design, and the blanket and shield designs. ERA

N77-22975# Los Alamos Scientific Lab., N. Mex.
TECHNOLOGY ASSESSMENT OF LASER-FUSION POWER PRODUCTION
L. A. Booth and T. G. Frank 1976 21 p refs Presented at 2nd Topical Meeting on the Technol. of Controlled Nucl. Fusion, Richland, Wash., 21 Sep. 1976
(Contract W-7405-eng-36)
(LA-UR-76-2060; CONF-760935-13) Avail: NTIS HC A02/MF A01

The inherent features of lase-induced fusion, some laser-fusion reactor concepts, and attendant means of utilizing the thermonu-

clear energy for commercial electric power generation are described. Theoretical fusion-pellet microexplosion energy release characteristics and the effects of pellet design options on pellet-microexplosion characteristics are discussed. The engineering feasibility of reactor cavities for which protection of cavity components is provided either by suitable ablative materials or by diversion of plasmas by magnetic fields is assessed. Two conceptual laser-fusion electric generating stations, based on different laser-fusion reactor concepts, are described. Technology developments for ultimate commercial application are outlined. ERA

N77-22998# California Univ., Berkeley. Lawrence Berkelev Lab.

ERDA INTERLABORATORY WORK FOR DATA EXCHANGE (IWGDE) Annual Report, Fiscal year 1976

Deane Merrill, ed. and Donald Austin, ed. Sep. 1976 138 p refs Revised

(Contract W-7405-eng-48)

(LBL-5329) Avail: NTIS HC A07/MF A01

The activities of the ERDA Interlaboratory Working Group for Data Exchange (IWGDE) during fiscal year 1976 are discussed. Created in response to an evident need for increased sharing of resources among ERDA installations, IWGDE was supported in FY 1976 through funds allocated to the Energy Analysis and Assessment programs of seven multipurpose ERDA national laboratories. Principal accomplishments include the interlaboratory exchange of socio-economic, environmental, demographic, and energy-related data bases, liaison development through interlaboratory meetings, creation of a national index of energy-related models and data bases, and definition and partial implementation of a computer-independent standard for exchange of data via magnetic tape. ERA

N77-23007*# Ultrasystems, Inc., Irvine, Calif.

EXAMINATION OF THE COSTS, BENEFITS AND ENERY CONSERVATION ASPECTS OF THE NASA AIRCRAFT FUEL CONSERVATION TECHNOLOGY PROGRAM

15 Nov. 1975 66 p refs

(Contract NASw-2859)

(NASA-CR-152683; Rept-8291-01) Avail: NTIS HC A04/MF A01 CSCL 05C

The costs and benefits of the NASA Aircraft Fuel Conservation Technology Program are discussed. Consideration is given to a present worth analysis of the planned program expenditures, an examination of the fuel savings to be obtained by the year 2005 and the worth of this fuel savings relative to the investment required, a comparison of the program funding with that planned by other Federal agencies for energy conservation, an examination of the private industry aeronautical research and technology financial posture for the period FY 76 - FY 85, and an assessment of the potential impacts on air and noise pollution. To aid in this analysis, a computerized fleet mix forecasting model was developed. This model enables the estimation of fuel consumption and present worth of fuel expenditures for selected commerical aircraft fleet mix scenarios. Author

N77-23008# Committee on Public Works and Transportation (U. S. House).

AVIATION ECONOMICS

Washington GPO 1976 600 p refs Joint hearings before Subcomm. on Investigations and Review and the Subcomm. on Aviation of the Comm. on Public Works and Transportation, 94th Congr., 2d Sess., 1-2, 4, 8, 10-11 Mar. and 27-29 Apr. 1976

(GPO-73-830) Avail: Subcomm. on Investigations and Review

Recommendations for government action to improve economic conditions in the air transportation industry are presented by officials of commercial airlines and members of the Civil Aviation Board. The impact of inflation on expenditures for fuel and replacement aircraft is discussed, as well as on return on investment. A.R.H.

N77-23010*# Denver Research Inst., Colo. Program for Transfer Research and Impact Studies.

SPACE BENEFITS: THE SECONDARY APPLICATION OF AEROSPACE TECHNOLOGY IN OTHER SECTORS OF THE ECONOMY

Sep. 1976 206 p

(Contract NASw-2607)

(NASA-CR-152685; DRI-9/76) Avail: NTIS HC A10/MF A01 CSCL 05B

A benefits briefing notebook is presented for the NASA Technology Utilization Office in which 515 applications of NASA aerospace technology to other sections of the economy are described. An overview of technology transfer is given. Benefit cases are cited in 19 categories along with pertinent information, such as communication link, DRI transfer example file, and individual case number. General, organization, geographic, and field center indexes are provided. Author

N77-23012# Brookhaven National Lab., Upton, N.Y.

SOLID WASTE AS AN ENERGY SOURCE FOR THE NORTHEAST

P. M. Meier and T. H. McCoy Jun. 1976 191 p refs

(Contract E(30-1)-16)

(BNL-50559; TID-4500) Avail: NTIS HC A09/MF A01

The potential contribution of energy recovery from municipal refuse to energy supply is assessed. A brief review of the present and likely future quantity and composition of municipal refuse and the technologies available for energy recovery is followed by a comparison of the potential contributions to energy supply of the various recovery options including direct firing in utility boilers, pyrolysis to oil or gas, and steam generation for industrial process heat or district space heating. The relationship of refuse energy recovery to market conditions for alternative energy sources is considered, which also includes an analysis of the impact of haul costs, interest rates, and delivered prices of the major fuels. ERA

N77-23021# Mitre Corp., McLean, Va.

ENVIRONMENTAL ASSESSMENT SAMPLING AND ANALYTICAL STRATEGY PROGRAM Final Report, Nov. 1975 - Jan. 1976

J. Vlahakis and H. Abelson May 1976 64 p

(Contract EPA-68-02-1859)

(PB-261259/6; EPA-600/2-76-093a) Avail: NTIS HC A04/MF A01 CSCL 13B

A costing methodology for environmental assessment was generated for industrial processes at various phases of development to provide a framework for determining industry, process, and stream priorities on the basis of a staged sampling and analysis technique. A screening phase characterizes the pollutant potential of influent and effluent streams of a process. Sampling and analysis provide for a quantitative representation of potentially hazardous substances in those streams identified for further investigation by the screening process. The procedure provides a mechanism for recommending assessment program implementation costs as well as for estimating costs for budgetary planning purposes. GRA

N77-23022# Illinois Univ., Urbana-Champaign. Water Resources Center.

MATHEMATICAL MODELS FOR USE IN PLANNING REGIONAL WATER RESOURCES AND ENERGY SYSTEMS

E. Downey Brill, Jr., S. Giray Velioglu, and Robert W. Fuessle Nov. 1976 96 p refs

(Contract DI-14-31-0001-4174)

(PB-261364/4; UILU-WRC-76-0116; W77-02079; OWRT-B-092-ILL(1)) Avail: NTIS HC A05/MF A01 CSCL 13B

Complex public sector problems such as: (1) the extent and development of coal conversion capacity, (2) interbasin transfer of water, (3) cooling technologies for large energy facilities, (4) diversion of Lake Michigan water, and (5) allowable withdrawal and consumptive uses of river water, all arise from the interlocking nature of the water resources-energy system. Mathematical

models are presented for use in planning a regional allocation of water for energy facilities as well as for other water uses. These models include components for the interrelated water and energy subsystems. The use of these models in conjunction with other existing models in order to provide a better picture of the overall system is discussed. GRA

N77-23072*# Douglas Aircraft Co., Inc., Long Beach, Calif.
COST/BENEFIT TRADEOFFS FOR REDUCING THE ENERGY CONSUMPTION OF THE COMMERCIAL AIR TRANSPORTATION SYSTEM. VOLUME 1: TECHNICAL ANALYSIS Final Report
E. F. Kraus Jun. 1976 289 p refs 2 Vol.
(Contract NAS2-8618)
(NASA-CR-137923; MDC-J7340-Vol-1) Avail: NTIS HC A13/MF A01 CSCL 05C

The effectiveness and associated costs of operational and technical options for reduced fuel consumption by Douglas aircraft in the domestic airline fleet are assessed. Areas explored include alternative procedures for airline and flight operations, advanced and state of the art technology, modification and derivative configurations, new near-term aircraft, turboprop configuration studies, and optimum aircraft geometry. Data for each aircraft studied is presented in tables and graphs. A.R.H.

N77-23073*# Douglas Aircraft Co., Inc., Long Beach, Calif.
COST/BENEFIT TRADEOFFS FOR REDUCING THE ENERGY CONSUMPTION OF THE COMMERCIAL AIR TRANSPORTATION SYSTEM. VOLUME 2: MARKET AND ECONOMIC ANALYSES Final Report
J. C. VanAbkoude Jun. 1976 374 p refs 2 Vol.
(Contract NAS2-8618)
(NASA-CR-137924; MDC-J7340-Vol-2) Avail: NTIS HC A16/MF A01 CSCL 05C

The impact of the most promising fuel conserving options on fuel consumption, passenger demand, operating costs, and airline profits when implemented into the U.S. domestic and international airline fleets is assessed. The potential fuel savings achievable in the U.S. scheduled air transportation system over the forecast period, 1973-1990, are estimated. Author

N77-23089*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DESIGN OF A LARGE SPAN-DISTRIBUTED LOAD FLYING-WING CARGO AIRPLANE
Lloyd S. Jernell and C. Baptiste Quartero (Vought Corp., Hampton, Va.) 22 Apr. 1977 99 p refs
(NASA-TM-X-74031) Avail: NTIS HC A05/MF A01 CSCL 01C

The design and operation of very large, long-range, subsonic cargo aircraft are considered. A design concept which distributes the payload along the wingspan to counterbalance the aerodynamic loads, with a resultant decrease in the in-flight wing bending moments and shear forces, is described. The decreased loading of the wing structure, coupled with the very thick wing housing the cargo, results in a relatively low overall structural weight in comparison to that of conventional aircraft. Author

N77-23106* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OIL COOLING SYSTEM FOR A GAS TURBINE ENGINE Patent
George A. Coffinberry (GE, Cincinnati) and Howard B. Kast, inventors (to NASA) (GE, Cincinnati) Issued 3 May 1977 9 p Filed 4 Feb. 1976 Division of US Patent Appl. SN-596641, filed 17 Jul. 1975 Sponsored by NASA
(NASA-Case-LEW-12830-1; US-Patent-4,020,632; US-Patent-Appl-SN-655149; US-Patent-Class-60-39.03; US-Patent-Class-60-39.28R; US-Patent-Class-60-39.66; US-Patent-Class-415-180; US-Patent-Class-123-41.33; US-Patent-Class-123-122E; US-Patent-Class-137-101; US-Patent-Appl-SN-596641) Avail: US Patent Office CSCL 21E

A gas turbine engine fuel delivery and control system is provided with means to recirculate all fuel in excess fuel control requirements back to the aircraft fuel tank. This increases the fuel pump heat sink and decreases the pump temperature rise without the addition of valving other than normally employed. A fuel/oil heat exchanger and associated circuitry is provided to maintain the hot engine oil in heat exchange relationship with the cool engine fuel. Where anti-icing of the fuel filter is required, means are provided to maintain the fuel temperature entering the filter at or above a minimum level to prevent freezing thereof. In one embodiment, a divider valve is provided to take all excess fuel from either upstream or downstream of the fuel filter and route it back to the tanks, the ratio of upstream to downstream extraction being a function of fuel pump discharge pressure.
Official Gazette of the U.S. Patent Office

N77-23109*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NASA QUIET CLEAN GENERAL AVIATION TURBOFAN (QCGAT) PROGRAM STATUS
D. L. Bresnahan and G. K. Sievers 1977 23 p Presented at Intern. Gas Turbine Conf., Philadelphia, Pa., 27-31 Mar. 1977; sponsored by ASME
(NASA-TM-X-73564; E-9008) Avail: NTIS HC A02/MF A01 CSCL 21E

The suitability of large engine technology to reduce noise, emissions, and fuel consumption of small turbine engines and develop new technology where required is determined. The design, fabrication, assembly, test, and delivery of the experimental engines to NASA are discussed. Author

N77-23114*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EMISSIONS AND TOTAL ENERGY CONSUMPTION OF A MULTICYLINDER PISTON ENGINE RUNNING ON GASOLINE AND A HYDROGEN-GASOLINE MIXTURE
John F. Cassidy Washington May 1977 38 p refs
(NASA-TN-D-8487; E-9105) Avail: NTIS HC A03/MF A01 CSCL 21A

A multicylinder reciprocating engine was used to extend the efficient lean operating range of gasoline by adding hydrogen. Both bottled hydrogen and hydrogen produced by a research methanol steam reformer were used. These results were compared with results for all gasoline. A high-compression-ratio, displacement production engine was used. Apparent flame speed was used to describe the differences in emissions and performance. Therefore, engine emissions and performance, including apparent flame speed and energy lost to the cooling system and the exhaust gas, were measured over a range of equivalence ratios for each fuel. All emission levels decreased at the leaner conditions. Adding hydrogen significantly increased flame speed over all equivalence ratios. Author

N77-23143# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN ENERGY MANAGEMENT GUIDANCE SCHEME APPLICABLE TO THE INTERIM UPPER STAGE M.S. Thesis
Jackie L. Roberts Dec. 1976 166 p refs
(AD-A034005; GA/EE/76-1) Avail: NTIS HC A08/MF A01 CSCL 22/3

A workable open loop guidance scheme for orbital transfer maneuvers is developed for a two stage solid-rocket vehicle which has no thrust termination capability. The scheme effectively manages any excess energy by matching a non-Hohmann transfer trajectory to the fixed energy capabilities of the vehicle. The entire burden of effecting the transfer is put on prelaunch targeting, so that during the burns the thrust can be directed along a precomputed direction using constant attitude maneuvers only. A computer program has been developed which employs a nonlinear equation solving routine to accomplish exact targeting for the finite-thrust transfer maneuver. The transfer trajectory is characterized by 6 control parameters (outputs of targeting, and the final orbit is defined by a set of 'hit conditions'. An error analysis is performed on the scheme throughout the range of possible trajectories which exist for excess energy missions. These trajectories are compared on the basis of optimality, such as

minimum insertion errors and transfer time. Results are presented for geosynchronous and subsynchronous transfers between circular orbits. GRA

N77-23175# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Div.
AMPS - SUBSATELLITE ASSESSMENT STUDY, VOLUME 1
Apr. 1976 134 p refs
(Contract ESTEC-2615/76-NI-PP(SC))
(MBB-URV-91-76-Vol-1; ESA-CR(P)-911-Vol-1) Avail: NTIS HC A07/MF A01

Results of a technical assessment study for atmospheric, magnetospheric, and plasma physics in space exploration (AMPS) by subsatellites to the Space Shuttle/Laboratory missions are presented. The model payloads, mission/orbit, spacecraft system, and subsystem aspects are dealt with. Interfaces to the Shuttle/Laboratory and the deployment/launching systems for Shuttle pallet launcher are considered. The most sophisticated version of the detached subsatellites, the attitude and orbit controlled spacecraft, OCSAT, was studied. Simple detached or tethered subsatellites were not considered. Three subsatellite candidates which appear feasible for a typical payload are described: silver/zinc battery power supply version, hybrid power supply version (battery system supported by solar cell generator), and fuel cell power supply version. ESA

N77-23277# Naval Ship Research and Development Center, Annapolis, Md. Materials Dept.
AN EVALUATION OF METHANOL, ETHANOL, THE PROPANOLS, AND THE BUTANOLS AS SHIP PROPULSION FUELS
Donald O. Newton Sep. 1976 14 p refs
(AD-A033483; MAT-75-20) Avail: NTIS HC A02/MF A01 CSCL 13/10

This report evaluates the alkyl monohydric alcohols from methanol through the butanols (C-1 to C-4) as Navy ship propulsion fuels. Properties of the alcohols from the technical literature are compared with the properties of Navy ship propulsion hydrocarbon fuels (Diesel Fuel Marine and JP-5). None of these alcohols is suitable as a direct substitute or as an extender for the currently used ship propulsion fuels. The use of methanol with its low volumetric energy content would entail over a 50 percent reduction in range between refuelings; the use of the other alcohols would result in roughly 25 percent to 40 percent loss of range. All the C-1 to C-4 alcohols have flash points below the 60 C minimum considered safe for shipboard fuels. Also, all have low cetane numbers, high water solubility, and problems with toxicity. However, methanol and mixtures of low-boiling alcohols are potentially usable as fuels for new ships specifically designed for their use. GRA

N77-23487*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CERAMIC APPLICATIONS IN THE ADVANCED STIRLING AUTOMOTIVE ENGINE
William A. Tomazic and James E. Cairelli 1977 13 p Presented at 5th Army Mater. Technol. Conf.: Ceramics for High Performance Appl., 2, Newport, R. I., 21-25 Mar. 1977; cosponsored by Army Mater. and Mech. Res. Center and DARPA
(Contract EC-77-A-31-1011)
(NASA-TM-X-73632; E-9131; ERDA/NASA-1011/77/2) Avail: NTIS HC A02/MF A01 CSCL 21A

The ideal cycle, its application to a practical machine, and the specific advantages of high efficiency, low emissions, multi-fuel capability, and low noise of the stirling engine are discussed. Certain portions of the Stirling engine must operate continuously at high temperature. Ceramics offer the potential of cost reduction and efficiency improvement for advanced engine applications. Potential applications for ceramics in Stirling engines, and some of the special problems pertinent to using ceramics in the Stirling engine are described. The research and technology program in ceramics which is planned to support the development of advanced Stirling engines is outlined. Author

N77-23490*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CERAMICS FOR THE ADVANCED AUTOMOTIVE GAS TURBINE ENGINE: A LOOK AT A SINGLE SHAFT DESIGN
Stanley M. Nosek 1977 12 p refs Presented at 5th Army Materials Technol. Conf. Ceramics for High Performance Applications, 2, Newport, R. I., 21-25 Mar. 1977; sponsored by AMMRC, ERDA, and DARPA
(NASA-TM-X-73651; E-9163) Avail: NTIS HC A02/MF A01 CSCL 21A

The results of a preliminary analysis of a single shaft regenerative design with a single stage radial turbine are presented to show the fuel economy that can be achieved at high turbine inlet temperatures, with this particular advanced design, if the turbine tip speed and regenerator inlet temperature are not limited. The engine size was 100 hp for application to a 3500 lb auto. The fuel economy was analyzed by coupling the engine to the auto through a continuously variable speed-ratio transmission and operating the system at constant turbine inlet temperature over the Composite Driving Cycle. The fuel was gasoline and the analysis was for a 85 F day. With a turbine inlet temperature of 2500 F the fuel economy was 26.2 mpg, an improvement of 18 percent over that of 22.3 mpg with a turbine inlet temperature of 1900 F. The turbine tip speed needed for best economy with the 2500 F engine was 2530 ft/sec. The regenerator temperature was approximately 2200 F at idle. Disk stresses were estimated for one single stage radial turbine and two two-stage radial-axial turbines and compared with maximum allowable stress curves estimated for a current ceramic material. Results show a need for higher Weibull Modulus, higher strength ceramics. Author

N77-23507# Transportation Systems Center, Cambridge, Mass.
THE 1975 AUTOMOTIVE CHARACTERISTICS DATA BASE Final Report, Jun. 1975 - 1976
Moses Rouse and William Basham Oct. 1976 136 p Sponsored by DOT
(PB-262015/1; DOT-TSC-OST-76-27) Avail: NTIS HC A07/MF A01 CSCL 13F

Automobile characteristics as a supportive tool for auto energy consumption, fuel economy monitoring, and fleet analysis studies are presented. The methods of vehicle sample selection, computation methods for statistical reports, illustrative output examples, and instructions for operating the data base are presented to fully represent the 1975 automobile fleet characteristics. GRA

N77-23518# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
FEDERAL SUPPORT FOR THE DEVELOPMENT OF ALTERNATIVE AUTOMOTIVE POWER SYSTEMS: THE GENERAL ISSUE AND THE STIRLING, DIESEL, AND ELECTRIC CASES Final Report, 1 Nov. 1974 - 30 Nov. 1975
Lawrence H. Linden, John B. Heywood, H. D. Vacoby, and Howard Margolis Mar. 1976 406 p refs
(Grants NSF OEP-74-21320; NSF EN-44166)
(PB-263523/3; MIT-EL-76-014; NSF/PRA-7421320-1-6) Avail: NTIS HC A18/MF A01 CSCL 21G

The federal government's role in supporting alternative automotive powerplant R and D for the explicit purpose of advancing the state-of-the-art is examined. An examination of the process by which major product technology changes occur in the automotive industry is reviewed. The automotive market is then examined for divergences between private and social costs and benefits, especially with respect to air pollution and fuel economy. Next the nature of the cost benefit analysis problem is discussed. Finally, three specific technologies are examined in detail and recommendations made as to government supported R and D for each. GRA

N77-23592# Arizona Univ., Tucson. Office of Arid Lands Studies.
GEOTHERMAL TECHNOECOSYSTEMS AND WATER CYCLES IN ARID LANDS

Christopher Duffield 1976 217 p refs
(Contract DI-14-31-0001-5254)
(PB-263091/1; Arid Lands Resource-IP-8; W77-03966; OWRT-A-197(5254)(1)) Avail: NTIS HC A10/MF A01 CSCL 08I

A literature review with its annotated bibliography is presented by taking into account the unusual developments in this field in the interim, new geothermal fields discovered, new demands for geothermal energy as an alternative source to more conventional sources, and a number of new publications reflecting accelerated research. GRA

N77-23593# California Univ., Riverside. Inst. of Geophysics and Planetary Physics.
TELLURIC MAPPING OVER THE MESA GEOTHERMAL ANOMALY, IMPERIAL VALLEY, CALIFORNIA
John P. Maas 1975 12 p refs Sponsored by NSF
(PB-262828/7; IGPP-UCR-75-10; NSF/RA/N-75-361) Avail: NTIS HC A02/MF A01 CSCL 08I

Telluric measurements were made at thirty-nine stations in the vicinity of the Mesa Geothermal Anomaly, Imperial Valley, California to evaluate the usefulness of the method as a geothermal prospecting tool. The area of investigation is characterized by thick (about 3 km) and highly conductive (resistivity on the order of 5 ohm-m) sediments. Relative ellipse areas were determined for the stations and plotted as total field and residual contour maps. These maps clearly reveal the presence of the thermal anomaly. They coincide well in geometry with the anomaly shown by shallow thermal gradient data and are consistent with temperature data from five deep wells in the area. GRA

N77-23594# Hawaii Univ., Honolulu. Geothermal Project.
THE HAWAII GEOTHERMAL PROJECT, INITIAL PHASE 2 PROGRESS REPORT
John W. Shupe, Augustine S. Furumoto, Paul C. Yuen, Robert M. Kamins, and Gordon A. MacDonald Feb. 1976 156 p refs Sponsored by NSF, ERDA, State of Hawaii, and County of Hawaii
(PB-263120/8; NSF/RA-760401) Avail: NTIS HC A08/MF A01 CSCL 08I

The identification, generation, and utilization of geothermal energy on the island of Hawaii are discussed. Overviews of four separate research programs are presented. GRA

N77-23597# Federal Power Commission, Washington, D. C. Bureau of Natural Gas.
PRELIMINARY INVESTIGATION. NONPRODUCING GAS RESERVES ONSHORE UNITED STATES AND IN THE GULF OF MEXICO OFFSHORE STATE AREA, AS REPORTED IN FEDERAL COMMISSION FORM 15
16 Sep. 1976 24 p refs
(PB-263434/3) Avail: NTIS HC A02/MF A01 CSCL 08I

Non-producing dedicated gas reserves onshore United States and in the Gulf of Mexico offshore state area are discussed. The result of an investigation undertaken to determine the extent of nonproducing interstate reserves is reported in FPC Form 15 (natural gas companies' annual report of gas supply). GRA

N77-23598 Auburn Univ., Ala.
TWO INVESTIGATIONS OF FLAT-PLATE SOLAR COLLECTOR PERFORMANCE Ph.D. Thesis
Jeffrey Herbert Morehouse 1976 163 p
Avail: Univ. Microfilms Order No. 77-4316

The heat loss from an operating solar collector is calculated from the experimentally determined equilibrium (no flow) heat transfer loss coefficient. Collector efficiency is then calculated for the cases when absorber plate temperature, average fluid temperature, and inlet fluid temperature are chosen as the independent parameters. A method for producing high temperatures using flat-plate collectors is presented. A radiation trap is described which mechanically reduces the effective emissivity of the absorber plate at a given temperature by reflecting some of the emitted radiation back onto the emitting surface. Circular and rectangular trap geometries are analyzed for absorber surface equilibrium temperature as a function of trap geometry and insolation value. Dissert. Abstr.

N77-23603*# Rockwell International Science Center, Thousand Oaks, Calif.
DEVELOPMENT OF AN (AlGaAs-Ga As) GRADED BAND GAP SOLAR CELL Final Report, 23 Oct. 1974 - 1 Oct. 1976
R. Sahai and J. S. Harris, Jr. Dec. 1976 63 p refs
(Contract NAS1-13548)
(NASA-CR-145161; SC5005.46FR) Avail: NTIS HC A04/MF A01 CSCL 10A

The results of an experimental program to develop the epitaxial growth techniques and analytical characterization techniques to fabricate graded bandgap solar cells are reported. Author

N77-23607# Pope, Evans, and Robbins, Inc., New York. Div. of Solar Energy.
SITE ENERGY HANDBOOK. VOLUME 1: METHODOLOGY FOR ENERGY SURVEY AND APPRAISAL
Oct. 1976 180 p refs
(Contract E(49-1)-3853)
(ERDA-76/131/1) Avail: NTIS HC A09/MF A01

The site energy survey and appraisal methodology and forms, as well as the site energy conservation opportunities presented in the Handbook, cover energy entering the site, energy generated on site, energy distributed and consumed on the site, and waste energy recovery. ERA

N77-23608# Energy Research and Development Administration, Washington, D.C. Div. of Solar Energy.
SITE ENERGY HANDBOOK. VOLUME 2: FORMS FOR ENERGY SURVEY AND APPRAISAL
Oct. 1976 271 p refs
(Contract E(49-1)-3853)
(ERDA-76/131/2) Avail: NTIS HC A12/MF A01

Forms are presented for use in describing, surveying, and appraising site energy, utility, and recoverable waste energy systems for natural gas, fuel oil, LPG, coal, electricity, steam, hot water, chilled water, compressed air, water supply, steam condensate, wastewater and solid waste. ERA

N77-23609# Oak Ridge National Lab., Tenn.
DEVELOPMENT AND APPLICATIONS OF SPATIAL DATA RESOURCES IN ENERGY RELATED ASSESSMENT AND PLANNING
R. J. Olson, F. G. Goff, and J. S. Olson 1976 9 p refs Presented at Proc. of the Advan. in Retrieval Technol. as Related to Inform. Systems, Arlington, Va., 20 Oct. 1976
(Contract W-7405-eng-26)
(CONF-761017-1) Avail: NTIS HC A02/MF A01

An investigation of potential changes in vegetation patterns related to predicted temperature changes from increased atmospheric CO2 is presented to illustrate an ongoing application of the data resources. Other themes include coal extraction in Appalachia, landscape patterns, habitat and population dynamics of selected biological species, and energy facility siting. ERA

N77-23610# California Univ., Livermore. Lawrence Livermore Lab.
THE 120-keV BEAM DIRECT CONVERSION SYSTEM FOR TFTR INJECTORS
G. W. Hamilton 21 Sep. 1976 20 p refs
(Contract W-7405-eng-48)
(UCRL-52137) Avail: NTIS HC A02/MF A01

A preliminary design is presented in which the most acute problems involved in scaling up existing designs and apparatus to fulfill TFTR requirements are analyzed. The requirements for electron suppression, gas pumping, compactness, and power densities are addressed. An idea is presented that allows for the handling of higher beam power. The gross savings in the capital cost of injector power supplies for the TFTR will be about $7.2 million, but the net savings will be somewhat less than this. ERA

N77-23613# Defence Research Establishment Ottawa (Ontario).
A COMPUTER PROGRAM TO CALCULATE AND PLOT WIND-GENERATED STORED ENERGY AT CONSTANT CONSUMPTION
E. M. L. Valeriote Jun. 1976 46 p
(AD-A029977; DREO-TN-76-15) Avail: NTIS HC A03/MF A01 CSCL 09/2

A computer program has been described which gives printed and plotted outputs of the quantity of wind-generated energy remaining in a storage system under given conditions. The program permits simulated variations of storage capacity, constant electrical load and conversion efficiency by simple data changes. Further alterations to the program itself are detailed, to adapt it to carry out similar calculations for wind turbines of various sizes of construction. The program has been tested by simulation of a hypothetical system of energy production, storage and consumption. It is planned that its predictions will be compared with data obtained from an experimental program currently in progress. Author (GRA)

N77-23614# Booz-Allen and Hamilton, Inc., Bethesda, Md.
PROCEDURES FOR FEASIBILITY ANALYSIS AND PRELIMINARY DESIGN OF TOTAL ENERGY SYSTEMS AT MILITARY FACILITIES Final Report
Nov. 1976 140 p refs
(Contract N62399-74-C-0029; DA Proj. 4A7-62720-A-896)
(AD-A033756; CERL-TR-E-96) Avail: NTIS HC A07/MF A01 CSCL 13/1

This manual provides procedural guidance and technical information for performing feasibility analyses and preliminary design of heat recovery installations, especially total energy and selective energy utility plants. This document is intended for use by facility and district engineers and for guidance of headquarters personnel. The feasibility analysis procedure is divided into five major steps: (1) identification of gross energy requirements; (2) assessment of the viability of heat recovery within the project environment; (3) assessment of user system constraints and energy requirements--(Site analysis and selection, load analysis); (4) definition of candidate system configurations; (5) technical and economic evaluation of candidate systems--(Energy efficiency analysis, economic analysis). GRA

N77-23616# National Bureau of Standards, Washington, D. C. Office of Energy Conservation.
ENERGY MANAGEMENT GUIDE FOR LIGHT INDUSTRY AND COMMERCE. EPIC ENERGY MANAGEMENT SERIES Final Report
W. J. Kelnhofer (Catholic Univ. of America, Washington, D. C.) and L. A. Wood Dec. 1976 31 p refs
(PB-263121/6; NBS-HB-120; LC-76-608281) Avail: NTIS HC A03/MF A01 CSCL 13A

Methods by which the manager of a small business can analyze his energy use, and determine the areas in which energy savings can be made are reported. The magnitude of the possible cost savings is estimated. A check list suggests some seventy items which might be important cost saving opportunities to an individual business. Eight of these opportunities are expanded in the appendix into miniature case studies illustrating simple methods for estimating savings. A listing of sources of assistance is included as a guide to obtaining consulting advice. GRA

N77-23617# Federal Power Commission, Washington, D. C. Bureau of Power.
THE PHASING OUT OF NATURAL GAS AND OIL FOR ELECTRIC POWER GENERATION, SOUTHWEST POWER POOL AND ELECTRIC RELIABILITY COUNCIL OF TEXAS. PART 2: TECHNICAL AND ECONOMIC EVALUATION OF VARIOUS POSSIBLE ELECTRIC UTILITY NATURAL GAS REDUCTION PROGRAMS, 1975 - 1990
30 Jul. 1976 250 p refs
(PB-263505/0) Avail: NTIS HC A11/MF A01 CSCL 10A

The technical and economic feasibility of programs for accelerating the phasing out of natural gas consumption by electric utilities in the southwest U.S. between 1975 and 1990 is evaluated. GRA

N77-23618# Sowle (Don) Associates, Inc., Arlington, Va.
A FEDERAL PROCUREMENT PLAN TO ACCELERATE USE OF SOLAR ENERGY
Dec. 1976 100 p
(Contract FEA-CO-05-50293-00)
(PB-263369/1; FEA/G-77/044) Avail: NTIS HC A05/MF A01 CSCL 05A

The Solar Energy Government Buildings Program (SEGEP) is a major commercialization project being developed by the Federal Energy Administration in conjunction with other agencies. This project will use a portion of the vast inventory of Federal buildings to provide an early and significant market for solar heating and hot water equipment and thus assist the early development of a solar heating and cooling industry infrastructure. This report addresses key features of Government procurement as part of an overall implementation plan for the SEGEP. The report reviews trends and techniques in Government procurement, discusses alternative strategies, and sets forth procurement plan to achieve SEGBP goals and objectives. GRA

N77-23619# Massachusetts Inst. of Tech., Cambridge. Energy Lab.
METHANOL AS AN AUTOMOTIVE FUEL: A SUMMARY OF RESEARCH IN THE M.I.T. ENERGY LABORATORY Final Report
Richard G. Donnelly, John B. Heywood, Jules LoRusso, Frank OBrien, Thomas B. Reed, and Rodney J. Tabaczynski Apr. 1976 57 p refs
(PB-262980/6; MIT-EL-76-013) Avail: NTIS HC A04/MF A01 CSCL 21D

The current status of studies on the use of methanol blends as automotive fuels is briefly reviewed. Experiments with a single-cylinder spark-ignition engine that methanol-gasoline blends show emissions and efficiency closely comparable to gasoline alone and that the blends yield a slight extension of the lean limit of operation. Methanol alone significantly extends the lean limit of operation and permits operation at much higher compression ratios with corresponding improvements in efficiency. GRA

N77-23620# Federal Power Commission, Washington, D. C. Office of Energy Systems.
STATE PROJECTIONS OF INDUSTRIAL FUEL NEEDS
Marquis R. Seidel Aug. 1976 136 p refs
(PB-263338/6) Avail: NTIS HC A07/MF A01 CSCL 21D

The issue of how higher fuel prices and conservation will change economic growth and fuel use at state and regional levels is addressed. The assembly of detailed and consistent data on fuel use, cross-sectional regressions on that data, and extrapolation of fuel requirements for 1990's economy are discussed. GRA

N77-23621# Federal Power Commission, Washington, D. C. Bureau of Natural Gas.
THE FUTURE OF NATURAL GAS: ECONOMIC MYTHS, REGULATORY REALITIES
S. William Yost Nov. 1976 30 p
(PB-263625/6) Avail: NTIS HC A03/MF A01 CSCL 21D

Conventional gas supplies (excluding Alaskan) past the year 2000 as well as the potential for supplementary supplies from Alaskan gas, LNG, and coal gasification during the same period are forecasted. The costs for these supplies are calculated, in constant dollars, for 1985 and 2000 using estimated quantities of new gas and rollover gas under existing FPC Opinions for these years. The prices of alternate fuels are also estimated, using the price rollup for crude and the expiration of contracts for coal. GRA

N77-23622# Hawaii Univ., Honolulu. Coll. of Engineering.
REGENERATIVE VAPOR CYCLE WITH ISOBUTANE AS WORKING FLUID

James C. S. Chou, Rajesh K. Ahluwalia, and Eric Y. K. Woo
10 Jun. 1974 32 p refs
(Grant NSF GI-38319)
(PB-262704/0; HGP-TR-4; NSF/RA/N-74-326) Avail: NTIS HC A03/MF A01 CSCL 08I

A regenerative heat exchanger, the increase in power production, and the reduction of the sizes of cooling equipment were investigated. Geothermal fluid from a well may exist in two phases, vapor and liquid, if the fluid is self-flowing. To avoid scaling, a submersible pump may be used to force the fluid out of the well. Effects of pumping on the power output and heat rejection of a binary cycle have also been evaluated with a specific set of given conditions, and the calculated results are included in this report. GRA

N77-23624# Rutgers - The State Univ., New Brunswick, N. J. Dept. of Electrical Engineering.
SILICON SCHOTTKY PHOTOVOLTAIC DIODES FOR SOLAR ENERGY CONVERSION Quarterly Progress Report, 1 Jul. - 30 Sep. 1976
William A. Anderson Oct. 1976 28 p refs
(Grant NSF AER-73-03197)
(PB-263172/9; NSF/RANN/SE/AER73-03197/PR-76; NSF/RA-760223) Avail: NTIS HC A03/MF A01 CSCL 10B

Fabrication studies have been made to evaluate electron-beam deposition of new Schottky metals, screem printed grids, and Tyco silicon. Schottky cells on Tyco silicon have been made with V sub ohm current = 0.5 V and an efficiency of 5.7%. Surface-state analysis continues to give a good agreement between experiment and theory. AR coating studies include sputtered ITO, spin-on coatings, and electron beam-evaporated Ta2O5. Environmental testing of cells has continued during this past quarter. GRA

N77-23625# Oklahoma State Univ., Stillwater. School of Electrical Engineering.
DEVELOPMENT AND ADAPTATION OF FIELD MODULATED GENERATOR SYSTEMS FOR WIND ENERGY APPLICATIONS Progress Report
R. Ramakumar, William L. Hughes, H. Jack Allison, R. K. Yarlagadda, and G. G. Smith 17 Oct. 1975 135 p refs
(Grant NSF AER-75-00647)
(PB-263604/1; NSF/RA/N-74-373) Avail: NTIS HC A07/MF A01 CSCL 10B

A specially designed test machine has been fabricated for the experimental investigation. The stator and rotor are being wound. The solid state inverter required for this system is being assembled in a conveniently transportable rack for testing. Parallel-bridge rectifier system studies were extended to include bridge-input capacitors for the case of resistive loads. Fourier analysis of source current and load current waveforms has been completed, and the results are presented in graphical form for different values of ratios. GRA

N77-23626# EIC, Inc., Newton, Mass.
STUDY OF SILICA SCALING FROM GEOTHERMAL BRINES Semiannual Progress Report, 15 May - 14 Nov. 1975
W. W. Harvey, P. OD. Offenhartz, G. F. Pearson, and J. Slaughter Jan. 1976 58 p refs Sponsored in part by NSF
(Contract E(11-1)-2607)
(PB-262890/7; NSF/RA-760397; COO-2607-2) Avail: NTIS HC A04/MF A01 CSCL 08I

Concurrent analyses for silicic acid monomer and total dispersed silica in a 2% brine at 95C and pH5 reveal a growth and decay of nonmonomeric silica concentration superimposed on the disappearance of monomer. The observed sequence suggests that monomer combines with polymeric species, and the latter grow and aggregate into flocculent silica or scale. GRA

N77-23631# Notre Dame Univ., Ind. Dept. of Civil Engineering.
CONTAMINATION OF GROUNDWATER BY HEAVY METALS FROM THE LAND DISPOSAL OF FLY ASH Technical Progress Report, 1 Jun. - 31 Aug. 1976
T. L. Theis 1 Oct. 1976 44 p refs
(Contract E(11-1)-2727)
(COO-2727-4) Avail: NTIS HC A03/MF A01

A useful method of differentiating surface from total heavy metals associated with fly ash is selective extraction for those metal oxide sinks (Fe, Al, Mn) with which the heavy metals have become associated. Lower pH values favor greater release or less adsorption in the system. Solubility, generally decreases with increasing pH. Even at neutral pH values, soluble complexes may increase the concentration of a given metal in excess of solubility. The average percentage of metals released for all fly ashes studied from their surface sinks at pH = 9 were cadmium-17 percent, lead-8 percent, chromium-6 percent, copper-1 percent, and zinc less than 1 percent. Another important factor is the absolute amount of metal on the surface. For instance, even though copper is released very little at neutral pH's, surface concentrations up to 200 micrograms/g of fly ash were found. ERA

N77-23635# Harry Diamond Labs., Adelphi, Md.
RESEARCH AND DEVELOPMENT ASSESSMENT ON SAFETY AND POLLUTION CONTROL FOR OUTER CONTINENTAL SHELF OPERATIONS Final Report
Maurice F. Funke and Bruce A. Weber Dec. 1976 51 p refs Sponsored in part by Geological Survey
(HDL Proj. A50634)
(AD-A034727; HDL-TR-1780) Avail: NTIS HC A04/MF A01 CSCL 08/9

An investigation has been made of the research, development, and data gathering that would provide some of the tools, both information and hardware, that could be used to increase safety and decrease pollution hazards associated with offshore oil and gas exploration and production. Methods have been identified for reducing the dangers to which both workers and structures are exposed during drilling, subsurface production, and transportation operations. These dangers include fire and explosion, asphyxiation, blowout, pollution, and unsafe rig conditions. GRA

N77-23894*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
JPL BASIC RESEARCH REVIEW
17 Mar. 1977 114 p refs
(Contract NAS7-100)
(NASA-CR-152689; JPL-Publ-77-5) Avail: NTIS HC A06/MF A01 CSCL 05B

Current status, projected goals, and results of 49 research and advanced development programs at the Jet Propulsion Laboratory are reported in abstract form. Areas of investigation include: aerodynamics and fluid mechanics, applied mathematics and computer sciences, environment protection, materials science, propulsion, electric and solar power, guidance and navigation, communication and information sciences, general physics, and chemistry. Author

N77-23936*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RESULTS OF CLOSED CYCLE MHD POWER GENERATION TEST WITH A HELIUM-CESIUM WORKING FLUID
Ronald J. Sovie 1977 10 p refs Presented at the 16th Symp. on the Engr. Aspects of Magnetohydrodynamics, Pittsburgh, Pa., 16-18 May 1977
(NASA-TM-X-73621; E-9112) Avail: NTIS HC A02/MF A01 CSCL 20I

The cross sectional dimensions of the MHD channel in the NASA Lewis closed loop facility were reduced to 3.8 x 11.4 cm. Tests were run in this channel using a helium-cesium working fluid at stagnation pressures of 160,000 n/M2, stagnation temperatures of 2000-2060 K and an entrance Mach number

of 0.36. In these tests Faraday open circuit voltages of 200 V were measured which correspond to a Faraday field of 1750 V/M. Power generation tests were run for different groups of electrode configurations and channel lengths. Hall fields up to 1450 V/M were generated. Power extraction per electrode of 183 W and power densities of 1.7 MW/M3 were obtained. A total power output of 2 kW was generated for tests with 14 electrodes. The power densities obtained in this channel represent a factor of 3 improvement over those previously reported for the M = 0.2 channel. Author

N77-23942# Princeton Univ., N. J. Plasma Physics Lab.
TOKAMAK HYBRID STUDY
F. H. Tenney Sep. 1976 12 p Presented at the Joint US-USSR Symp. on Fusion-Fission Reactors, Livermore, Calif., 13-16 Jul. 1976
(Contract E(11-1)-3073)
(PPPL-1284; Conf-760733-6) Avail: NTIS HC A02/MF A01

A Tokamak hybrid reactor is studied. The plasma is maintained by both D and T beams. To obtain long burn times a poloidal field divertor is required. Both the single null and the double null style of divertor are considered. The blanket consists of a neutron multiplier region containing natural uranium followed by burner regions of molten salt (flibe) loaded with PuF3 to enhance the energy multiplication. Economic analysis has been applied only recently to a variety of reactor sizes and plasma conditions. Early indications suggest that the most attractive hybrids will have large plasmas of major radius in excess of 8 meters. ERA

N77-23951# Wisconsin Univ., Madison. Dept. of Nuclear Engineering.
WHAT IS PAST IS PROLOGUE: FUTURE DIRECTIONS IN TOKAMAK POWER REACTOR DESIGN RESEARCH
R. W. Conn 1976 17 p refs Presented at 2nd. Topical Meeting on the Technol. of Controlled Nucl. Fusion, Richland, Wash., 21 Sep. 1976 Sponsored by ERDA, EPRI, and Wisconsin Electric Utilities Research Foundation
(UWFDM-175; Conf-760935-43) Avail: NTIS HC A02/MF A01

The trends towards reduced reactor size and higher neutron loadings are discussed. Moving in this direction requires new approaches to many subsystem designs. New approaches and future directions in first wall and blanket designs that can achieve reliable operation and reasonable lifetime, the use of cyrogenic but normal aluminum magnets for the pulsed coils in a tokamak, blanket designs that allow elimination of the intermediate loop, and low activity shields and toroidal field magnets are described. A discussion is given of the future role of conceptual reactor design research and the need for close interactions with ongoing experiments in fusion technology. ERA

N77-23952# General Electric Co., Philadelphia, Pa. Space Div.
MHD GENERATOR INVESTIGATIONS Annual Report, 1 Jan. - 30 Sep. 1976
C. H. Marston, E. Tate, and B. Zauderer Nov. 1976 85 p refs
(Contract N00014-73-C-0039)
(AD-A032790) Avail: NTIS HC A05/MF A01 CSCL 20/9

Feasibility of self-excited MHD operation has been shown. Eight percent magnetic field augmentation using an initial field of 0.5 Tesla was obtained. The NASA Ames EAST facility capabilities as a high temperature, high pressure plasma source have been mapped in detail. A channel (Ames I) has been used on the EAST facility to check test-time, aerodynamic performance and construction materials. Design and construction of a preliminary (Ames II) pulsed, self-excited, MHD generator concept was completed. GRA

N77-24002# Qei, Inc., Bedford, Mass.
FACTORS IN THE PLANNING OF A NATIONAL INFORMATION SYSTEM FOR RENEWABLE ENERGY Final Report
J. W. Kuipers, R. W. Thorpe, and F. W. Lancaster 30 Jun. 1976 224 p refs
(Grant NSF SIS-75-12766)
(PB-262003/7; Rept-6930) Avail: NTIS HC A10/MF A01 CSCL 05B

A national information system for the renewable energy field is proposed. The system is intended to serve the scientific and technical communities as well as the management, technology, industrial, policy making, and the general public components of the energy field. It is proposed that in order to achieve improvements in communication between information communities and within communities, a system be set up which comprises a distributed network of satellite centers with a coordinating headquarters center. Satellite centers in the system consist of Information Resource and Analysis Centers (IRACs) for particular information areas. IRACs are to be designated for each defined information area in the energy fields of interest and are to be responsible for acquiring, organizing and maintaining all information of interest in a given area. GRA

N77-24008 California Univ., Berkeley.
ENERGY RECOVERY THROUGH BIOGASIFICATION OF MUNICIPAL SOLID WASTES AND UTILIZATION OF THERMAL WASTES FROM AN ENERGY-URBAN-AGRO-WASTE COMPLEX Ph.D. Thesis
Luis Florentino Diaz 1976 254 p
Avail: Univ. Microfilms Order No. 77-4347

Experiments on the anaerobic digestion of the organic fraction of municipal refuse were performed. Objective of the experiments was to stabilize and simultaneously produce a fuel from a particular fraction of the municipal solid waste. The scale of the experiments ranged from laboratory (4 to 9 liter) cultures to small pilot plant (1600 liter) digesters. The refuse used as feed was enriched by the addition of raw sewage sludge in various ratios. Organic loading rates ranged from 0.067 to 0.4 lbs VS/cu ft 3 -day. Typical hydraulic detention times were 15 and 30 days. Temperatures were kept within the range of 85 F to 105 F. Digestion efficiency was based on energy conversion and gas production. A simulation study was also conducted in which energy derived from solid waste conversion and from thermal waste discharges was used to meet certain energy requirements of an energy-urban-agro-waste complex. In the study, a community was integrated with its electric generating station, wastewater treatment plant, refuse processing plant, and food production facilities. Dissert. Abstr.

N77-24011*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NASA TECHNOLOGY UTILIZATION HOUSE TECHNICAL SUPPORT PACKAGE
[1976] 43 p
(NASA-TM-X-74686) Avail: NTIS HC A03/MF A01 CSCL 13M

Special systems and features incorporated in the NASA Technology Utilization House are described. These include solar energy utilization, energy conservation techniques, water recycling, hot water systems, security systems, and other design features. D.M.L.

N77-24018# National Academy of Sciences - National Research Council, Washington, D. C.
TECHNOLOGY TRANSFER FROM FOREIGN DIRECT INVESTMENT IN THE UNITED STATES. REPORT OF A SEMINAR SERIES Final Report
1976 77 p refs Seminars held in New York, 2-5 Feb. 1976 Sponsored in part by Commerce Dept.
(Contract NSF C-310; Grant NSF PRA-76-15037)
(PB-263012/7; NSF/PRA-7615037-1-77) Avail: NTIS HC A05/MF A01 CSCL 05A

Four sectors of industry were studied to determine the impact of direct foreign investment on technology transfer. No significant net technology outflow was observed in the manufacturing of petrochemicals, pharmaceuticals, non-electric machinery, electronics and computers, or scientific instruments. GRA

N77-24019# Pratt (R. H.) Associates, Inc., Kensington, Md.
THE POTENTIAL FOR TRANSIT AS AN ENERGY SAVING OPTION Final Report
Phillip S. Shapiro and Richard H. Pratt Mar. 1976 109 p refs
(Contract FEA-CO-04-50077-00)
(PB-263087/9; FEA/D-76/224) Avail: NTIS HC A06/MF A01 CSCL 13B

The potential impacts and energy efficiencies of short-term policies designed to induce auto drivers to shift to public transit were studied. An analysis is made of the energy efficiencies of various urban passenger transportation modes, including automobile, bus, rapid rail, commuter rail, and Dial-A-Ride transit. Policies to induce mode shifts to public transit are structured into alternative scenarios for evaluation. Possible urbanized area transportation energy savings as well as reductions in vehicle miles of travel are estimated first for individual representative cities and then expanded to a national level. Representative cost evaluations of policy actions are included as well. Finally, note is made of projected secondary or indirect impacts of policy design and implementation. GRA

N77-24103# Federal Aviation Administration, Washington, D. C.
REPORT TO CONGRESS BY THE FEDERAL AVIATION ADMINISTRATION ON THE ENERGY EFFICIENCY OF AGENCY REGULATIONS Final Report
Nov. 1976 133 p
(AD-A034611) Avail: NTIS HC A07/MF A01 CSCL 10/1

All regulations and laws administered by the FAA were examined for their effect on energy consumption. An inventory of regulations requiring activities which lead to fuel usage was prepared and organized. The following general groupings were identified: (1) flight test programs; (2) environmental control; (3) aircraft fuel supply; (4) aircraft speed and flight altitude; (5) airspace and air traffic control; (6) aircraft equipment; (7) crewmember qualifications. GRA

N77-24205 British Library Lending Div., Boston Spa (England).
METHOD AND EQUIPMENT FOR THE INTRODUCTION OF LIQUID WASTE FUELS INTO A FLUIDIZED LAYER
Pavel Novotny and Karel Hanyk. Nov. 1976 6 p Transl. into ENGLISH from Czech patent no. 158913 (1975)
(BLL-RTS-10400) Avail: British Library Lending Div., Boston Spa, Engl.: £3.00; 3 BLL overseas, 3 European or 12 UK BLL photocopy coupons

A method and equipment for feeding liquid waste fuels into a fluidized layer while changing the composition of the fuel being introduced is described. The problem of self-supported combustion of different kinds of liquid flammable wastes with a minimum requirement for fitting out the equipment and with simple operation is solved. The combustion of the waste fuel takes place in a two-stage fluid burner with a relative shortage of air in such a way that the surplus of air in the fluid reactor is always less than unity, and the combustible gas leaving the fluid reactor is not burned until the second focus of combustion. Author

N77-24245 British Library Lending Div., Boston Spa (England).
ECONOMICS AND ORGANIZATION OF METALLURGICAL PRODUCTION: EFFECTIVENESS OF THE USE OF MAGNETIC FIELDS IN MELTING ALLOY STEELS
I. I. Ivanov, L. F. Vorobeva, and G. V. Bergauz [1976] 7 p Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Chern. Met. (USSR), no. 5, 1976 p 183-185
(BLL-M-25473-(5828.4F)) Avail: British Library Lending Div., Boston Spa, Engl.

The technical and economic effectiveness of using a magnetic field from a solenoid for remelting alloy steels in a water-cooled mold beneath a layer of flux was investigated. When ball bearing, structural, stainless, and heat resistant steels are remelted in a magnetic field the quality of the metal is improved. Heat duration is reduced by 1.0-1.3 h, the specific electric power consumption is reduced 15-20%, and furnace delivery is raised by 18-25%. The reduction in the cost of ingots is, depending on the grade of steel, 1.6-4.0%, while the specific capital outlay on the remelting plant is reduced by 15-20%. Author

N77-24265# Oak Ridge National Lab., Tenn. Chemistry Div.
CORROSIVITY OF GEOTHERMAL BRINES Progress Report
F. A. Posey and A. A. Packo Dec. 1976 35 p refs
(Contract W-7405-eng-26)
(ORNL-TM-5688) Avail: NTIS HC A03/MF A01

The corrosivity of ferrous materials in synthetic geothermal brines was studied. Electrochemical measurements on the spontaneous corrosion potentials and corrosion rates, and on the kinetics of the anodic and cathodic corrosion reactions of iron and carbon steel were made in 4 M NaCl solution over the pH range from 1 to 11 at temperatures up to 100 C in a conventional Pyrex electrochemical cell. A refreshed, stirred titanium autoclave system was designed, constructed, and tested, and will be used for making electrochemical measurements in synthetic brines up to at least 200 C. The effect of pH on hydrolysis, precipitation, and electrochemical reactivity of ferrous and ferric ions in 4 M NaCl at 25 C was studied, and implications for plant operation are discussed. The pitting potential of Type 304 stainless steel in synthetic brine was measured as a function of temperature from 25 to 85 C. Plans for research on electrochemical aspects of the corrosion of iron and carbon steel in synthetic geothermal brines during FY1977 are presented. ERA

N77-24314# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
FUELS AND LUBRICANTS Final Report on Test Operations Procedure
2 Jul. 1976 34 p refs
(AD-A032842; TOP-2-2-701) Avail: NTIS HC A03/MF A01 CSCL 21/4

A method is prescribed for evaluating military fuel and lubricant compatibility with Army vehicles and a method for sampling and spectrometric analysis of lubricants for symptoms of metal wear or contamination. Equipment and facilities and basic test requirements are described. Tests for octane and cetane requirements; engine, transmission, and vehicle compatibility; cold starting; and hydraulic, gear oil, and grease systems are described. A chart is included of typical fuels and lubricants for Army vehicles and equipment. Author (GRA)

N77-24316# Battelle Columbus Labs., Ohio.
COMBUSTION ADDITIVES FOR POLLUTION CONTROL: A STATE-OF-THE-ART REVIEW Final Task Report, May 1972 - Dec. 1975
H. H. Krause, L. J. Hillenbrand, Albert E. Weller, and David W. Locklin Jan. 1977 106 p refs
(Contract EPA-68-02-0262)
(PB-264068/8; EPA-600/2-77-008a) Avail: NTIS HC A06/MF A01 CSCL 21D

A state-of-the-art review is presented of the potential of combustion-type fuel additives in reducing air pollutant emissions from oil and coal firing. A review of the relation of combustion mechanisms to additive action in controlling emissions; and a review of experimental investigations of combustion-type fuel additives are reported. The evidence for control by fuel additives of visible smoke and carbon particulate is relatively strong; that for control of polycyclic organic matter is somewhat weaker. GRA

N77-24318# Institute of Gas Technology, Chicago, Ill.
ASSESSMENT APPLICATION FOR DIRECT COAL COMBUSTION Final Report
Mark E. Fejer, Peter A. Ketels, Marie-Therese Kouo, Jack D. Nesbitt, and Donald R. Shoffstall Oct. 1976 268 p refs
(Contract NSF C-924; IGT Proj. 8970)
(PB-263651/2; NSF/PRA-7505072) Avail: NTIS HC A12/MF A01 CSCL 21D

The feasibility of converting 9 processes within 24 SIC energy-intensive industries to pulverized coal with minimum cost and environmental impacts was analyzed. Selection of the candidate processes was based on its use of direct process heat, contribution to the total industry energy consumption pattern, and level of emissions and emission control. Factors assessed include: ability to maintain its thermal requirements, product quality, furnace requirements, and pollution level of particulate matters, sulfur oxides, and nitrogen oxides with coal firing. Results indicated that pulverized coal can fulfill the requirements of cement and lime calcining, iron ore beneficiation, blast furnace, open hearth, glass melting for container glass production, and brick firing which can be immediately converted with minimum environmental impact. GRA

N77-24319# Federal Power Commission, Washington, D. C. Office of Economics.
INCREMENTAL PRICING OF SUPPLEMENTAL GAS
Aug. 1976 54 p refs
(PB-263689/2) Avail: NTIS HC A04/MF A01 CSCL 21D

Efficiency, equity, and administrative aspects of incremental and rolled-in pricing are covered. The feasibility of implementing incremental pricing at both the pipeline and burner tip levels is studied. Implications of combining a retail resale market with an incremental pricing scheme are discussed. GRA

N77-24320# Federal Power Commission, Washington, D. C. Bureau of Natural Gas.
THE GAS SUPPLIES OF INTERSTATE NATURAL GAS PIPELINE COMPANIES, 1975
28 Jan. 1977 125 p
(PB-263598/5) Avail: NTIS HC A06/MF A01 CSCL 21D

A statistical summary of the year-end 1975 total reserves and deliverability of the interstate pipeline companies and pertinent comparisons is provided. GRA

N77-24321# Federal Energy Administration, Washington, D. C. Office of Energy Information and Analysis.
PETROLEUM MARKET SHARES - A REPORT ON SALES OF REFINED PETROLEUM PRODUCTS, 1972 THROUGH 1975: AVIATION GASOLINE, JET FUELS, MIDDLE DISTILLATE FUEL OILS, RESIDUAL FUEL OIL, MOTOR GASOLINE
30 Apr. 1976 183 p refs
(PB-262726/3; FEA/B-76/308) Avail: NTIS HC A01/MF A01 CSCL 21D

Market share information for refiners and independent marketers of aviation gasoline, jet fuels, middle distillate fuel oil, residual fuel oil, and motor gasoline is presented. In general, information is presented for the period January 1972 through December 1975. The gasoline market share information is directed primarily towards changes in 1975. GRA

N77-24332*# TRW Defense and Space Systems Group, Redondo Beach, Calif.
TRANSMITTER EXPERIMENT PACKAGE FOR THE COMMUNICATIONS TECHNOLOGY SATELLITE
B. Farber, D. S. Goldin, B. Marcus, and P. Mock [1977] 200 p refs
(Contract NAS3-15839)
(NASA-CR-135035) Avail: NTIS HC A09/MF A01 CSCL 17B

The operating requirements, system design characteristics, high voltage packaging considerations, nonstandard components development, and test results for the transmitter experiment package (TEP) are described. The TEP is used for broadcasting power transmission from the Communications Technology Satellite. The TEP consists of a 12 GHz, 200-watt output stage tube (OST), a high voltage processing system that converts the unregulated spacecraft solar array power to the regulated voltages required for OST operation, and a variable conductance heat pipe system that is used to cool the OST body. Author

N77-24340*# National Aeronautics and Space Administration. Pasadena Office, Calif.
PHASE CONJUGATION METHOD AND APPARATUS FOR AN ACTIVE RETRODIRECTIVE ANTENNA ARRAY Patent Application
Robert C. Tausworthe (JPL) and Ralph C. Chernoff, inventors (to NASA) (JPL) Filed 16 Mar. 1977 36 p
(Contract NAS7-100)
(NASA-Case-NPO-13641-1; US-Patent-Appl-SN-777983) Avail: NTIS HC A03/MF A01 CSCL 17B

An active retrodirective antenna array is described in which a reference array element is used to generate a phase reference which is replicated at succeeding elements of the array. Each element of the array is associated with a phase regeneration circuit and the phase conjugation circuitry of an adjacent element. In one implementation, the phase reference circuit operates on the input signal at the reference element, a voltage controlled oscillator output signal, and the input pilot signal at the next array element received from a transmission line. In another implementation, particularly suited for large arrays in space, two different input pilot frequencies are employed. Their difference is the phase reference of the system, and a local oscillator is used in obtaining this difference, which is in the IF range. In both implementations, appropriate mixing and filtering is performed to achieve phase conjugation and phase reference replication. NASA

N77-24371# Gulton Industries, Inc., High Point, N. C.
DESIGN MODIFICATION OF FEMCO MODEL 702909 WIRELESS GROUND MONITOR Final Report
Leonard F. Vitt Jul. 1976 31 p
(Contract DI-BM-H0166034)
(PB-262858/4; BM-OFR-15-77) Avail: NTIS HC A03/MF A01 CSCL 08I

Femco Model 702909 Wireless Ground Monitor was modified as follows: (1) a voltage regulator was added to prevent false trips withline voltage variations; (2) a ground wire trap was designed to eliminate problems with parallel paths and provide spark suppression; (3) a three-phase filter was designed to permit complete test of installed systems and (4) the design was modified to insure trip with an open ground wire in the event of a failure of any one semiconductor component. GRA

N77-24381 British Library Lending Div., Boston Spa (England).
THE TURBO-GENERATOR WITH SUPERCONDUCTING FIELD WINDING IN TRANSIENT OPERATION
H. Fuerisch Dec. 1976 14 p refs Transl. into ENGLISH from Arch. fuer Elektrotech. (W. Berlin), v. 57, no. 6, 1976 p 291-296
(BLL-RTS-10351) Avail: British Library Lending Div., Boston Spa, Engl.: £7.50; 7 BLL overseas, 8 European or 30 UK BLL photocopy coupons

For a model of a turbogenerator with superconducting winding which is suitable for mathematical treatment, the specific current loads produced by the windings are given for arbitrary variation of the currents with time. A two-dimensional field analysis yields the magnetic fundamental harmonic fluxes linked with the windings and forms the voltage differential equations. Along with the form of the electromagnetically developed torque and the equations of motion describing the behavior of the mechanical union, the system equations of the generator are obtained. Author

N77-24410# Battelle Columbus Labs., Ohio.
DESTATOR TEST PROGRAM EVALUATION Final Report, 26 Feb. 1974 - 31 Aug. 1976
S. A. Hawk and R. B. Reif 8 Jul. 1976 41 p refs
(Contract DOT-CG-23223)
(AD-A034260; USCG-D-130-76) Avail: NTIS HC A03/MF A01 CSCL 13/12

Explosions that occurred in three very large crude tankers in December, 1969, called attention to a probable electrostatic problem related to washing operations in the large tanks. The Destator is a system designed to sense charge in a tank being cleaned and to control the magnitude of that charge. The report is an evaluation of those tests. Conclusions and comments are given. GRA

N77-24430# Massachusetts Inst. of Tech., Oak Ridge, Tenn. School of Chemical Engineering Practice.
DESIGN CONSIDERATIONS FOR CAPILLARY HEAT PIPES AT CRYOGENIC TEMPERATURES
S. P. Sukhia, G. C. Coletta, and H. C. Pellow 13 Oct. 1967 36 p refs
(Contract W-7405-eng-26)
(ORNL-MIT-28) Avail: NTIS HC A03/MF A01

A cryogenic heat pipe was suggested as an efficient means of transferring heat from a cooled component on a spacecraft. A thermodynamic analysis of the heat pipe operation, at cryogenic temperatures, leads to the conclusion that the radiant heat leak into the system establishes a minimum temperature difference for efficient operation-the criterion being the absence of fluid boiling in the wick. A design equation for the maximum heat transport in the wick is presented, and correlations for wicking characteristics and wick dimensions are established. A preliminary design for the spacecraft heat pipe is presented. Operating conditions and physical dimensions of the heat pipe and wick are specified. Possible wick materials and configurations are discussed, and a specific approach for experimentation is recommended. ERA

N77-24431# Los Alamos Scientific Lab., N. Mex.
CERAMIC HEAT PIPE HEAT EXCHANGERS
W. A. Ranken Sep. 1976 8 p refs
(Contract W-7405-eng-36)
(LA-6514-MS) Avail: NTIS HC A02/MF A01

High-temperature strength, resistance to corrosive atmospheres, and moderate cost combine to make ceramic materials an obvious choice for construction of high-temperature thermal energy recuperator systems. Despite these advantages, ceramic recuperators are steadily being replaced by metallic units at considerable sacrifice in maximum air or fuel preheat temperatures and hence in recovery efficiency. By constructing a recuperator from ceramic heat pipes, the number of joints and the thermal stress to which they are subjected can be greatly reduced, and very low leakage rates can, in principle, be obtained. Methods of fabricating ceramic heat pipes are described and a conceptual recuperator design is presented. Potential applications of this type of unit are also briefly discussed. ERA

N77-24483# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ANALYSIS OF THE SUN PUMPED LASER CONE OPTICS M.S. Thesis
Perry Michael Towles Sep. 1976 60 p refs
(AD-A034284; GEP/PH/76-11) Avail: NTIS HC A04/MF A01 CSCL 20/5

A meridional ray analysis is accomplished on the solar energy collector part of a sun pumped laser. A Gaussian approximation is completed and shows a solar image 0.57 inches in diameter is located 3.81 cm from the end of the laser rod. The image is inside the laser cavity. For 200 watts available at the primary mirror of the Cassegrainian System, it is found that only about 150 watts is furnished to the cone lens for through put. Only about 66 percent of the available 150 watts is collected by the cone lens and channelled to the laser rod by the condensing cone. The last is found by a skew ray analysis of some rays coming from the outer radial part of the primary mirror. These rays are traversing the system all the way to the cone lens, but are diverging before entering the lens and therefore not being collected by the condenser cone. An analysis is made of the exit angle of the power traversing the condenser cone. The analysis was made so that an AR coating of the appropriate material and thickness could be put on the laser rod for maximum collection of the solar energy wavelengths used in pumping the Nd:YAG laser rod. GRA

N77-24504# Stanford Research Inst., Menlo Park, Calif.
LONG TERM ENERGY ALTERNATIVES FOR AUTOMOTIVE PROPULSION. SYNTHETIC FUEL VERSUS BATTERY/ ELECTRIC SYSTEM
E. E. Hughes, B. L. Walton, P. M. Newgard, J. W. Ryan, R. V. Steele, E. M. Dickson, S. M. Kohan, J. B. Kopelman, E. D. Oliver, and P. M. Halton Aug. 1976 17 p
(Contract NSF C-915; Grant NSF OEP-75-16162; SRI Proj. EGU-4064)
(PB-262512/7; SRI-EGU-4064; NSF/PRA-7516162; Rept-5) Avail: NTIS HC A01/MF A01 CSCL 13F

Conventional automobiles deriving fuel from coal by coal liquefaction processes are compared with electric cars using advanced batteries (such as the high temperature lithium-sulfur battery). Four comparison criteria--ease of transition from the present system, economics, energy requirements and environmental quality--were applied. GRA

N77-24505# Stanford Research Inst., Menlo Park, Calif.
LONG TERM ENERGY ALTERNATIVES FOR AUTOMOTIVE PROPULSION: SYNTHETIC FUEL VERSUS BATTERY/ ELECTRIC SYSTEM Final Report
E. E. Hughes, B. L. Walton, P. M. Newgard, J. W. Ryan, R. V. Steele, E. M. Dickson, S. M. Kohan, J. B. Kopelman, E. D. Oliver, and P. M. Halton Aug. 1976 281 p refs
(Contract NSF C-915; Grant NSF OEP-75-16162; SRI Proj. EGU-4064)
(PB-262513/5; SRI-EGU-4064-FR; NSF/PRA-751616162-1-6) Avail: NTIS HC A13/MF A01 CSCL 13F

For abstract, see N77-24504.

N77-24514# Faucett (Jack) Associates, Inc., Chevy Chase, Md.
TRUCK FLEET EXPERIENCE WITH FUEL ECONOMY IMPROVEMENT MEASURES
Jul. 1976 136 p refs
(Contract FEA-CO-04-50135)
(PB-263022/6; FEA/D-76/392) Avail: NTIS HC A07/MF A01 CSCL 13F

The major steps taken by the trucking industry to save fuel are reviewed. It includes a discussion of experience with individual conservation measures and contains a series of case studies detailing the various fuel economy improvements efforts of individual companies. GRA

N77-24561*# ECON, Inc., Princeton, N.J.
AN EVALUATION OF SEASAT-A CANDIDATE OCEAN INDUSTRY ECONOMIC VERIFICATION EXPERIMENTS Final Report
1 Apr. 1977 249 p refs
(Contract NASw-3047)
(NASA-CR-153009; Rept-76-242-1) Avail: NTIS HC A11/MF A01 CSCL 05C

A description of the candidate economic verification experiments which could be performed with SEASAT is provided. Experiments have been identified in each of the areas of ocean-based activity that are expected to show an economic impact from the use of operational SEASAT data. Experiments have been identified in the areas of Arctic operations, the ocean fishing industry, the offshore oil and natural gas industry, as well as ice monitoring and coastal zone applications. Author

N77-24571# Southwest Research Inst., San Antonio, Tex. Div. of Geothermal Energy.
DEVELOPMENT OF AN ASSESSMENT METHODOLOGY FOR GEOPRESSURIZED ZONES OF THE UPPER GULF COAST BASED ON A STUDY OF ABNORMALLY PRESSURED GAS FIELDS IN SOUTH TEXAS Final Report
R. K. Swanson, P. Oetking, J. S. Osoba, and R. C. Hagens Aug. 1976 122 p refs
(Contract E(11-1)-2687)
(COO-2687-5) Avail: NTIS HC A06/MF A01

Individual fields were assessed for their potential to produce large quantities of geothermal fluid based on reservoir study and detailed geological investigation. Five locations within the study region have been selected as potential candidates for further evaluation and possible eventual testing. Based on investigation of permeability and temperature, the upper limit of fluid

temperature likely to be produced in the lower south Texas study region is 300 F. In Live Oak County, the possibility of producing fluid at higher temperatures is somewhat improved, with a reasonable possibility of producing fluid at 350 to 375 F. ERA

N77-24572# Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.
STRATEGIC PETROLEUM RESERVE DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR CENTRAL ROCK MINE
Dec. 1976 463 p refs
(PB-262390/8; EEA/S-76/489; DES-76-9) Avail: NTIS HC A20/MF A01 CSCL 21D

The present action is part of the ESR (Energy Storage Reserve) and proposes to store 14 million barrels of oil in an underground limestone mine located in Lexington, Kentucky. The proposed storage of oil at Central Rock Mine would be implemented at an existing underground limestone mine presently owned and operated by the Central Rock Company. This site-specific Environmental Impact Statement (EIS) has identified particularly sensitive environmental parameters that were investigated. GRA

N77-24573# Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.
STRATEGIC PETROLEUM RESERVE. DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR IRONTON MINE
Dec. 1976 487 p refs
(PB-262451/8; FEA/S-76/490) Avail: NTIS HC A21/MF A01 CSCL 21D

The Federal Energy Administration (FEA) proposes to implement the Strategic Petroleum Reserve to mitigate the social and economic impacts of any future interruptions of petroleum imports. The Reserve will store 150 million barrels of oil by December of 1978 in the Early Storage Reserve (ESR), and 500 million barrels by 1982 under the entire program. Particularly sensitive environmental parameters for the Ironton, Ohio Early Storage Reserve site are identified. GRA

N77-24577# Stanford Univ., Calif. Dept. of Petroleum Engineering.
MATHEMATICAL MODELLING OF SINGLE-PHASE NONISOTHERMAL FLUID FLOW THROUGH POROUS MEDIA Ph.D. Thesis
Paul Gardiner Atkinson May 1976 209 p refs
(Grant NSF AER-72-03490-A03)
(PB-262884/0; NSF/RA-760404) Avail: NTIS HC A10/MF A01 CSCL 08I

A series of mathematical models are developed to describe heat transfer in laboratory experiments using cylindrical cores in a Hassler-type coreholder. The models are general and can also be used to study behavior encountered in other laboratory arrangements. Analytical solutions are derived and the behavior of these solutions is studied to determine the interaction of the heat transfer mechanisms in laboratory cores. The mathematical models are evaluated by comparison of calculated results with published experimental data. GRA

N77-24579# Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.
STRATEGIC PETROLEUM RESERVE. BRYAN MOUND SALT DOME Final Environmental Impact Statement
Jan. 1977 534 p refs
(PB-262839/4; FEA/S-76/502; FES-76/77-6) Avail: NTIS HC A23/MF A01 CSCL 21D

The implementation of Strategic Petroleum Reserve (SPR), of the Energy Policy and Conservation Act of 1975 initiated the development of a 58 million barrel crude oil storage facility at the Bryan Mound Salt Dome. The purpose of the SPR is to mitigate the economic impacts of any future interruptions of the petroleum imports. Under the initial phase of the SPR, referred to as the Early Storage Reserve (ESR), one hundred fifty million barrels of oil will be stored by 1978. The Bryan Mound site, a salt dome with existing cavities located in Brazoria County, Texas, has been identified as a candidate site of the ESR because it offers the advantage of large storage capacity, easy access to the distribution network, and a relatively short preparation period. This site-specific EIS analyzes the environmental impacts caused by site preparation and operation. GRA

N77-24580# Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.
STRATEGIC PETROLEUM RESERVE. WEST HACKBERRY SALT DOME Final Environmental Impact Statement
Jan. 1977 616 p refs
(PB-262508/5; FEA/S-76/503; FES-76/77-4) Avail: NTIS HC A99/MF A01 CSCL 21D

Under the initial phase of the SPR (Strategic Petroleum Reserve), referred to as the Early Storage Reserve (ESR), one hundred fifty million barrels of oil will be stored by 1978. This site-specific EIS analyzes the environmental impacts caused by site preparation and operation. GRA

N77-24581*# Solarex Corp., Rockville, Md.
SOLAR BREEDER: ENERGY PAYBACK TIME FOR SILICON PHOTOVOLTAIC SYSTEMS
Joseph Lindmayer Apr. 1977 57 p refs Prepared for JPL (Contracts NAS7-100; JPL-954606)
(NASA-CR-153060; QR-1; ERDA/JPL-954606-77/1; SX/111/1Q) Avail: NTIS HC A04/MF A01 CSCL 10A

The energy expenditures of the prevailing manufacturing technology of terrestrial photovoltaic cells and panels were evaluated, including silicon reduction, silicon refinement, crystal growth, cell processing and panel building. Energy expenditures include direct energy, indirect energy, and energy in the form of equipment and overhead expenses. Payback times were development using a conventional solar cell as a test vehicle which allows for the comparison of its energy generating capability with the energies expended during the production process. It was found that the energy payback time for a typical solar panel produced by the prevailing technology is 6.4 years. Furthermore, this value drops to 3.8 years under more favorable conditions. Moreover, since the major energy use reductions in terrestrial manufacturing have occurred in cell processing, this payback time directly illustrates the areas where major future energy reductions can be made -- silicon refinement, crystal growth, and panel building. Author

N77-24582*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF A 1.8 BY 3.7 METER FRESNEL LENS SOLAR CONCENTRATOR
Leon J. Hastings, Steve L. Allums, and Warren S. Jensen Apr. 1977 75 p refs
(NASA-TM-X-73392) Avail: NTIS HC A04/MF A01 CSCL 10A

Line-focusing acrylic Fresnel lenses with application potential in the 200 to 370 C range are analytically and experimentally evaluated. Investigations previously conducted with a 56 cm wide lens were extended to experimentation/analyses with a 1.8 by 3.7 m lens. A measured peak concentration ratio of 64 with 90 percent of the transmitted energy focused into a 5.0 cm width was achieved. A peak concentration of 61 and a 90 percent target width of 4.5 cm were analytically computed. The experimental and analytical lens transmittance was 81 percent and 86 percent, respectively. Thus, the analytical/experimental lens performance correlation is considered good. The lens also was interfaced with a receiver assembly and operated in the collection mode. The collection efficiency ranged from 42 percent at 100 C to 26 percent at 300 C, whereas an efficiency of 40 percent at 300 C was anticipated. Apparently, the reflective cavity surrounding the absorber tube did not perform as expected. Author

N77-24585*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
CRITICAL AREAS: SATELLITE POWER SYSTEMS CONCEPTS

Jul. 1975 168 p
(NASA-TM-X-74694; JSC-10873) Avail: NTIS HC A08/MF A01 CSCL 10A

Critical Areas are defined and discussed in the various areas pertinent to satellite power systems. The presentation is grouped into five areas (General, Space Systems, Solar Energy Conversion, Microwave Systems, and Environment/Ecology) with a sixth area (Power Relay) considered separately in an appendix. Areas for Future Consideration as critical areas are discussed in a second appendix. Author

N77-24586# Lockheed Missiles and Space Co., Palo Alto, Calif.
USE OF RADIATION REFLECTED FROM EARTH TO INCREASE THE POWER OF SOLAR PANELS
N. M. Bordina, N. A. Borisova, G. S. Daletskii, V. V. Zaode, A. K. Zaitseva, A. P. Landsman, and U. A. Letin [1976]. 8 p refs Transl. into ENGLISH from Kosm. Issled. (USSR), v. 14, no. 2, 1976 p 293-298
Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

Computations of the direct and earth-reflected solar radiation fluxes reaching the panels of solar batteries (SP) mounted on an artificial earth satellite are presented. Different modes of SP orientation are considered. An estimate is made to intensify SP power using radiation reflected from earth on two-sided SP. Author

N77-24587*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BASELINE PERFORMANCE OF SOLAR COLLECTORS FOR NASA LANGLEY SOLAR BUILDING TEST FACILITY
Richard H. Knoll and Susan M. Johnson Washington May 1977 25 p refs
(NASA-TM-X-3505; E-9036) Avail: NTIS HC A02/MF A01 CSCL 10A

The solar collector field contains seven collector designs. Before operation in the field, the experimental performances (thermal efficiencies) of the seven collector designs were measured in an indoor solar simulator. The resulting data provided a baseline for later comparison with actual field test data. The simulator test results are presented for the collectors as received, and after several weeks of outdoor exposure with no coolant (dry operation). Six of the seven collector designs tested showed substantial reductions in thermal efficiency after dry operation. Author

N77-24588# Energy Research and Development Administration, Washington, D.C. Div. of Solar Energy.
AN ECONOMIC ANALYSIS OF SOLAR WATER AND SPACE HEATING
Nov. 1976 74 p refs
(DSE-2322-1) Avail: SOD HC $1.85

Solar system designs for 13 cities were optimized so as to minimize the life cycle cost over the assumed 20 year life time of the solar energy systems. The major assumptions regarding the solar system, type and use of building, financial considerations, and economic environment used in the design optimization were included. Author

N77-24590*# National Aeronautics and Space Administration. Pasadena Office, Calif.
SUN TRACKING SOLAR ENERGY COLLECTOR Patent Application
Gerald S. Perkins, inventor (to NASA) (JPL) Filed 6 Apr. 1977 12 p
(Contract NAS7-100)
(NASA-Case-NPO-13921-1; US-Patent-Appl-SN-785257) Avail: NTIS HC A02/MF A01 CSCL 10A

A parabolic reflector is supported so that it can track the sun. The support for this reflector comprises an azimuth frame supported on two wheels and a central pivotal point which are positioned in a substantially triangular configuration. The two wheels rotate on tracks. On top of the azimuth frame, there is provided an elevation frame. The elevation frame includes curved rails which define a portion of an arc and extend vertically. The reflector rides on wheels captured within the curved rails. The wheels of the azimuth frame are driven by an azimuth actuator. The reflector structure is counterbalanced about its elevation axis by a pendulum cable system which is driven by a motor to change elevation. At the focal point of the parabolic reflector, a heat engine or receiver is mounted independently of the reflector. Author

N77-24591# Western Forest Products Lab., Vancouver (British Columbia).
ENERGY SELF-SUFFICIENCY PROSPECTS FOR THE BRITISH COLUMBIA FOREST PRODUCTS INDUSTRY
R. S. Evans Apr. 1977 23 p refs
(VP-X-166) Avail: NTIS HC A02/MF A01

The analysis indicates that in each of the sub-zones, the industry could be independent of natural gas, and that a net residue surplus would still remain in four sub-zones sufficient to sustain thermal-electric-generating plants with an aggregate capacity of 175 megawatts. New or improved technologies for recovery of energy from hog fuel are identified. Wood gasification offers the greatest potential for replacing natural gas. Author

N77-24592*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL EVALUATION OF A BREADBOARD HEAT AND PRODUCT-WATER REMOVAL SYSTEM FOR A SPACE-POWER FUEL CELL DESIGNED WITH STATIC WATER REMOVAL AND EVAPORATIVE COOLING
Norman H. Hagedorn and Paul R. Prokipius Washington May 1977 27 p ref
(NASA-TN-D-8485; E-8822) Avail: NTIS HC A03/MF A01 CSCL 10A

A test program was conducted to evaluate the design of a heat and product-water removal system to be used with fuel cell having static water removal and evaporative cooling. The program, which was conducted on a breadboard version of the system, provided a general assessment of the design in terms of operational integrity and transient stability. This assessment showed that, on the whole, the concept appears to be inherently sound but that in refining this design, several facets will require additional study. These involve interactions between pressure regulators in the pumping loop that occur when they are not correctly matched and the question of whether an ejector is necessary in the system. Author

N77-24593*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD FOR FABRICATING SOLAR CELLS HAVING INTEGRAL COLLECTOR GRIDS Patent Application
John C. Evans, Jr., inventor (to NASA) Filed 6 Jun. 1977 16 p
(NASA-Case-LEW-12819-1; US-Patent-Appl-SN-803823) Avail: NTIS HC A02/MF A01 CSCL 10A

A heterojunction barrier photovoltaic device is described. It comprises a heterojunction or Schottky barrier device, a conductive base metal layer compatible with and coating predominately the exposed surface of the p-type substrate of the device such that a back surface field region is formed at the interface between the device and the base metal layer, a transparent, conductive mixed metal oxide layer in integral contact with the n-type layer of the heterojunction or Schottky barrier device having a metal alloy grid network of the same metal elements of the oxide constitutents of the mixed metal oxide layer embedded in the mixed metal oxide layer, an insulating layer which prevents electrical contact between the conductive metal base layer and the transparent, conductive metal oxide layer, and a metal contact means coverging the insulating layer and in intimate contact with the metal grid network embedded in the transparent, conductive oxide layer for conducting electrons generated by the photovoltaic process from the device. NASA

N77-24594# Oak Ridge National Lab., Tenn.
PROCESS ENERGY RELIABILITY REQUIREMENTS FOR SELECTED INDUSTRIES
W. G. Sullivan and T. M. West Sep. 1976 58 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5428) Avail: NTIS HC A04/MF A01

Twenty-nine responses to the mail-out questionnaire were returned, and data were analyzed with respect to steam generator characteristics, types of fuels used, amounts of electrical energy purchased or sold, and reliabilities of the steam-supply system. Reliability referred to the percentage of clock time that sufficient amounts of steam energy were available to permit desired production quotas to be met at a particular plant. For the 17 chemical industries, study results showed that reliabilities ranged from 100 to 89 percent, and the average value was 98 percent. The nine petroleum refineries experienced an average steam-supply system reliability of 92 percent, with individual refinery reliabilities ranging from 100 to 70 percent. Finally, there were only three primary metals companies represented in the study, and their process energy reliabilities were 100 percent. ERA

N77-24595# Brookhaven National Lab., Upton, N.Y.
FUTURE NATURAL GAS SUPPLY TO THE NORTHEAST
R. N. Langlois Apr. 1976 77 p refs
(Contract E(30-1)-16)
(BNL-50558) Avail: NTIS HC A05/MF A01

Based on estimates of total U.S. gas reserves (discovered and undiscovered) and applying a modified Hubbert method to a number of assumptions, projections of natural gas production were made for 1985 and 2000. From these, the amount of gas supply available to the Northeast was projected based on further assumptions, e.g., if there is gas deposit on the Atlantic Outer Continental Shelf, whether it will be developed in time, how much of the Alaskan gas is available to this part of the nation, etc. The conclusion is that under most scenarios the supply of natural gas to the Northeast will be severly constrained. ERA

N77-24596# Brookhaven National Lab., Upton, N.Y.
PLANNER'S ENERGY WORKBOOK: A USERS' MANUAL FOR LAND USE AND ENERGY UTILIZATION
1976 23 p Presented at the Am. Inst. of Planners New England Regional Meeting, Hyannis, Mass., 11 Jun. 1976 Prepared in cooperation with State Univ. of New York, Stony Brook
(Contract E(30-1)-16)
(BNL-21546; Conf-760660-1) Avail: NTIS HC A02/MF A01

The analysis of energy demand and fuel consumption in the residential sector, the commercial sector, the industrial sector, and the transportation sector in the U.S. is summarized. Each of the parameters that enter into the analysis is described for each sector. ERA

N77-24597# Brookhaven National Lab., Upton, N.Y.
ALTERNATIVE PATTERNS OF INDUSTRIAL ENERGY CONSUMPTION IN THE NORTHEAST
R. J. Gottle, IV Mar. 1976 61 p refs
(Contract E(30-1)-16)
(BNL-50555) Avail: NTIS HC A04/MF A01

Data sources, assumptions, and methodology employed to construct the 1972 industrial energy consumption in the region are discussed. Utilizing this base-year information and existing projections and assumptions of underlying economic phenomena, a number of alternative energy-consumption patterns were calculated for the northeastern industrial sector in the years 1985 and 2000. ERA

N77-24598# Oak Ridge National Lab., Tenn.
ELECTROSTATIC ENERGY STORAGE
R. L. Macklin Sep. 1976 9 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5529) Avail: NTIS HC A02/MF A01

The advantages of capacitor storage of energy, particularly for automotive use, are reviewed and compared with alternatives. A few suggestions for research possibilities for possibly suitable organic dielectrics are given. ERA

N77-24599# Oak Ridge National Lab., Tenn.
ANNUAL CYCLE ENERGY SYSTEM: INITIAL INVESTIGATIONS
H. C. Fischer, J. C. Christian, E. C. Hise, A. S. Holman, A. J. Miller, W. R. Mixon, J. C. Moyers, and E. A. Nephew Oct. 1976 65 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5525) Avail: NTIS HC A04/MF A01

Initial analytical and experimental investigations were conducted to establish data and design procedures prior to a demonstration of the Annual Cycle Energy System (ACES) in an actual building. ACES is an integrated system for supplying space heating and cooling, and domestic hot water to a building through the use of a heat pump, a thermal storage unit, and an outdoor radiative/convective panel. The heat pump extracts energy from a tank of stored water to provide winter heating. The ice that is formed is accumulated for subsequent use in meeting the cooling requirements of the building in the summer. A components test assembly was constructed to measure the rates of heat transfer during ice buildup and brine operations, to assess the design requirements of the evaporator and the desuperheater for producing domestic hot water. ERA

N77-24600# Owens-Illinois, Inc., Toledo, Ohio.
EVALUATION OF AN ALL-GLASS, EVACUATED, TUBULAR, NON-FOCUSING, NON-TRACKING SOLAR COLLECTOR ARRAY
1976 44 p
(Contract E(11-1)-2919)
(TID-27192) Avail: NTIS HC A03/MF A01

An evaluation of an advanced design evacuated tubular all-glass solar collector using air as the heat transfer fluid and having the potential of producing an exit fluid temperature in excess of 250 F at an efficiency of greater than 40 percent is presented. The test systems are operated over a wide range of mass flow rates and inlet temperatures under selected steady state conditions. In addition, the systems are operated in a control mode simulating an air conditioning cycle. ERA

N77-24601# California Univ., Livermore. Lawrence Livermore Lab.
RESEARCH LEADING TO THE PRODUCTION AND EARLY USE OF NUMERIC DATA BANKS OF MATERIAL PROPERTIES AND SYSTEM ANALYSES Quarterly Progress Report, Apr. - Jun. 1976
Viktor E. Hampel 16 Sep. 1976 31 p refs
(Contract W-7405-eng-48)
(UCRL-50038-76-2) Avail: NTIS HC A03/MF A01

A bibliographic data base for flywheel energy-storage systems was created. Work was continued on the systems structure for the energy-storage data bases. A test of this prototype data-base structure was begun for data on properties of salts used in thermal storage systems. Preliminary definitions were developed for data bases to permit the analysis and intercomparison of energy-storage systems. ERA

N77-24603# Waterloo Univ. (Ontario).
WATSUN: A SOLAR HEATING SIMULATION AND ECONOMIC EVALUATION PROGRAM User's Manual
J. F. Orgill and K. G. T. Hollands Apr. 1976 88 p refs
(NP-21307) Avail: NTIS (US Sales Only) HC A05/MF A01; ERDA Depository Libraries

The modules contained within WATSUN consist of system rather than component models with the exception of an optional flat-plate collector model. The result of using system rather than component models is reduced computational effort and associated costs allowing for the evaluation of a wide range of system sizes. ERA

N77-24604# Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia).
PROGRESS REPORT ON THE PERFORMANCE OF THREE AUSTRALIAN SOLAR HOT WATER SYSTEMS
H. Salt Sep. 1976 29 p refs
(SES-8) Avail: NTIS (US Sales Only) HC A03/MF A01; ERDA Depository Libraries

Three Australian hot water systems were monitored. These systems are of different areas, and the hot water usage patterns at the three installations are very different. The systems are described and tables are presented showing the energy consumed in providing the hot water, the fraction of this which was provided by the solar part of the system and the efficiency with which the system was able to convert the solar radiation incident on the collectors to hot water required by the users. The tables show that the hot water usage pattern plays a significant part in determining the overall solar system performance. ERA

N77-24606# California Univ., Livermore. Lawrence Livermore Lab. Div. of Solar Energy.
UNITED STATES SPECIAL FORMAT REPORT: PERFORMANCE OF THE SOHIO SOLAR WATER HEATING SYSTEM USING LARGE AREA PLASTIC COLLECTORS (GRANTS, NEW MEXICO)
W. C. Dickinson May 1976 39 p refs
(Contract E(04-3)-1038)
(SAN-1038-76-1) Avail: NTIS HC A02/MF A01

Performance measurements have been made with this system over a period of about one year. Plans and specifications have just been completed for a full-sized system consisting of 72 SSP (Sohio Solar Power) modules, each 3.5 m by 60 m. ERA

N77-24609# Institute of Gas Technology, Chicago, Ill.
MOLTEN SALT THERMAL ENERGY STORAGE SYSTEMS: SALT SELECTION
H. C. Maru, H. F. Dullea, and V. S. Huang Aug. 1976 61 p refs
(Contract E(11-1)-2888)
(COO-2888-1) Avail: NTIS HC A04/MF A01

A total of 31 inorganic salts and salt mixtures, including 9 alkali and alkaline earth carbonate mixtures, were evaluated for their suitability as heat-of-fusion thermal energy storage materials at temperatures of 850 to 1000 F. Thermophysical properties, safety hazards, corrosion, and cost of these salts were compared on a common basis. It is concluded that because alkali carbonate mixtures show high thermal conductivity, low volumetric expansion on melting, low corrosivity and good stability, they are attractive as heat-of-fusion storage materials in this temperature range. ERA

N77-24611# Waterloo Univ. (Ontario).
DETERMINING THE TECHNICAL AND ECONOMIC FEASIBILITY OF UTILIZING SOLAR ENERGY FOR HEATING BUILDINGS IN CANADA Yearly Report, Project No. 4107
K. G. T. Hollands and J. F. Orgill Apr. 1976 47 p refs
Sponsored by National Research Council, Canada
(NP-21308) Avail: NTIS (US Sales Only) HC A03/MF A01; ERDA Depository Libraries

The development of a computer model for solar heating systems and development of a method for utilizing incomplete solar data are presented. ERA

N77-24612# Argonne National Lab., Ill.
ELECTRIC STORAGE HEATING: THE EXPERIENCE IN ENGLAND AND WALES AND IN THE FEDERAL REPUBLIC OF GERMANY
J. G. Asbury and A. Kouvalis May 1976 30 p refs
(Contract W-31-109-eng-38)
(ANL/ES-50) Avail: NTIS HC A03/MF A01

The policies, methods, and circumstances under which electric storage heating was commercialized in Europe are reviewed, and background information for evaluating the feasibility of commerical applications in the United States is given. ERA

N77-24615# European Space Agency, Paris (France).
THE CYLINDRICAL PARABOLIC MIRROR AS REFLECTOR FOR SOLAR COLLECTORS-EFFICIENCIES AND OPTIMIZATION
Rainer Koehne Apr. 1977 50 p refs Transl. into ENGLISH of 'Der parabolische Zylinderspiegel als Reflektor fuer Solarkollektoren Wirkungsgrade u. Optimierungsbetrachtungen', DFVLR, Stuttgart Report DLR-FB-76-55, 27 Oct. 1976 Original report in GERMAN previously announced as N77-20607 Original German report available from DFVLR, Cologne DM 15,90
(ESA-TT-365; DLR-FB-76-55) Avail: NTIS HC A03/MF A01

After introducing the concentration ratio and intercept-factor of focusing collectors with parabolic cylinder mirrors the energy balance equations were derived to determine the efficiencies under steady state conditions. The components of the collector were varied and optimized with respect to maximum efficiency. Furthermore the dynamic behavior of the collector was calculated and the average efficiencies compared with the efficiencies in the steady state condition. Author (ESA)

N77-24616# Federal Energy Administration, Washington, D. C. Office of Energy Conservation and Environment.
SECOND QUARTERLY REPORT TO US HOUSE AND SENATE COMMITTEES ON APPROPRIATIONS
Jul. 1976 35 p refs
(PB-263418/6; FEA/D-77/045) Avail: NTIS HC A03/MF A01 CSCL 10A

Progress of the Federal Energy Administration (FEA) energy conservation programs and short and long term accomplishments is described. An overview briefly summarizing the programs, focusing on new programs and significant changes in the scope of existing programs is included. Highlights of the current status of the programs, including indicators of energy consumption and conservation and major activities conducted during the reporting period are given, and new publications are listed. Author

N77-24618# UOP, Inc., Des Plaines, Ill.
OPTIMIZATION OF PT-DOPED KOCITE (R) TRADEMARK ELECTRODES IN H3 PO4 FUEL CELLS Interim Progress Report, Feb. - Aug. 1976
R. N. Leverle Oct. 1976 58 p refs
(Contract DAAG53-76-C-0014; DA Proj. 1G7-62708-AH-67)
(AD-A034604) Avail: NTIS HC A04/MF A01 CSCL 10/2

The use of UOP Pt-impregnated Kocite materials as low cost air and/or fuel electrocatalysts in phosphoric acid electrolyte fuel cells is being optimized. Kocite(R) materials are composite structures consisting of pyropolymers chemically bonded to refractory substrates. Fuel cell electrodes are fabricated from those materials and tested as anodes or cathodes in model fuel cells with Teflon bonded Pt black counter electrodes. Kocite is being produced in 200-400 gram quantities from a high surface area alumina with a particle size of about 500 nm. From the Pt-impregnated Kocite, electrodes with a porous graphite paper current collector are being fabricated by both hand and machine calendering operations with 0.125, 0.25, and 0.50 mg/sq cm Pt loadings. When tested in model phosphoric acid fuel cells with 2 mg/sq cm Pt black counter electrodes, full-cell IR-free performances of 0.62 and 0.71 volts as air and oxygen cathodes, respectively, have been obtained at 100 ma/sq cm and 149 C using 0.25 mg/sq cm Pt-loaded Kocite electrodes. Lifetime testing of Kocite electrodes as cathodes indicates no catalyst deterioration occurs for periods in excess of 500 hours for temperatures from 140 to 180 C. In order to optimize the structure of Kocite electrodes, the teflon content, density, and thickness of the Kocite catalyst layer have been systematically varied. GRA

N77-24619# Stanford Univ., Calif. Systems Optimization Lab.
ENERGY MODELS AND LARGE-SCALE SYSTEMS OPTIMIZATION
George B. Dantzig and Shailendra C. Parikh Nov. 1976 11 p refs
(Contracts N00014-75-C-0267; N00014-75-C-0865)
(AD-A033736; SU-SOL-76-23) Avail: NTIS HC A02/MF A01 CSCL 12/2

The optimization of large-scale dynamic systems represents a central area of research whose successful outcome could make important contributions to the analysis of crucial national and world problems. Although a great number of papers have been published on the theory of solving large-scale systems, not much in software exists that can successfully solve such systems.

It is believed that there has been little progress, because there has been little in the way of extensive experimentation comparing methods under laboratory-like conditions on representative models. At Stanford's Systems Optimization Laboratory (SOL), to bridge this gap between theory and application, experimental software for solving large-scale dynamic systems has been developed, proposed techniques on representative models have been systematically compared, and information regarding experimental results has been recorded and disseminated. This report gives an overview of some of the work being done at the Systems Optimization Laboratory. GRA

N77-24620# Societal Analytics Inst., Inc., Dallas, Tex.
BARRIERS TO THE USE OF WIND ENERGY MACHINES: THE PRESENT LEGAL/REGULATORY REGIME AND A PRELIMINARY ASSESSMENT OF SOME LEGAL/POLITICAL/SOCIETAL PROBLEMS
Rita Falk Taubenfeld and Howard J. Taubenfeld Jul. 1976 159 p refs
(Grant NSF AER-75-18362)
(PB-263576/1; NSF/RA-760422) Avail: NTIS HC A08/MF A01 CSCL 10B

The present state of law and regulation at all levels of government that may affect wind energy machines is analyzed. Also analyzed and assessed is the state of analogous and related law and regulation, requirements at various levels of government, and international rules, as wind machines grow larger and/or are used in arrays. It suggests some potential impacts of the development of wind-based power technology on selected aspects of the American economy, particularly on the energy delivering utilities. GRA

N77-24622# Mitre Corp., McLean, Va.
SOLAR ENERGY GOVERNMENT BUILDINGS PROGRAM POLICY AND IMPLEMENTATION PLAN
Jan. 1977 232 p refs
(Contract FEA-CR-05-60704-00)
(PB-262841/0; FEA/D-77/032) Avail: NTIS HC A11/MF A01 CSCL 13A

The costs and benefits of several feasible scales of implementation of such a program to support the decision as to whether the program should be implemented, and if so, at what level, are discussed. Several alternative administrative arrangements for implementing the program if approved are presented. GRA

N77-24626# Battelle Pacific Northwest Labs., Richland, Wash.
THE USE OF GEOTHERMAL ENERGY AT MILITARY INSTALLATIONS Research Report, 1 Sep. - 15 Oct. 1976
W. R. McSpadden Oct. 1976 71 p refs Sponsored by DARPA
(AD-A034241) Avail: NTIS HC A04/MF A01 CSCL 10/1

This report is a result of a review of eight ARPA funded projects conducted to identify: (1) geothermal resources for military installations and (2) key problems for their development. Of these, four projects dealt with identification and evaluation of resources; two dealt with problems associated with the chemistry of geothermal fluids, in particular corrosion and scaling; one project was concerned with the critical problem of drilling for geothermal resources; and one was a review of the current state-of-the-art of geothermal energy development. As a result of these studies, two target areas have been identified as prime candidates for development of geothermal energy at military installations: The Coso Hot Springs, on the Naval Weapons Center at China Lake, CA, and the Marine Corps base at Twenty-nine Palms, CA. In addition, two test sites are proposed in southern Texas for research and development of geopressured systems. As of the beginning of FY 77, the Coso Geothermal Site is under active exploration and development with research funding from ERDA. The objectives of these eight ARPA funded research projects have been accomplished. GRA

N77-24627# Office of Naval Research, London (England).
INTERNATIONAL SYMPOSIUM ON WIND ENERGY SYSTEMS
Robert H. Nunn 7 Dec. 1976 28 p Conf. held at Cambridge, Engl., 7-9 Sep. 1976
(AD-A034871; ONRY-C-31-76) Avail: NTIS HC A03/MF A01 CSCL 10/1

Vertical- and horizontal-axis systems were discussed both in theory and in practice. Applications ranged from wind forms, each with hundreds of megawatt units, to the use of Cretan windmills to provide water for cattle. Wind energy conversion units have been operated in several configurations and the theory of their performances is sufficiently advanced to allow design for fabrication. The trends are towards larger units for municipal power systems and smaller units for domestic use. In the former case, the behavior of large wind turbines operating in large arrays, and the output (with and without storage) of several such arrays when geographically dispersed, has yet to be well understood. The field has reached a level of maturity characterized by such factors as economics, environmental impact, and public acceptance. GRA

N77-24628# Boston Univ., Mass. Dept. of Chemistry.
PHOTOCHEMICAL CONVERSION OF SOLAR ENERGY Semiannual Progress Report, 1 Jan. - 30 Jun. 1976
Norman N. Lichtin 28 Oct. 1976 31 p refs
(Grant NSF AER-72-03579-A05)
(PB-262450/0; NSF/RA-760354; NSF/RANN/SE/AER72-03579/A05-76) Avail: NTIS HC A03/MF A01 CSCL 07E

The dependence of the composition and kinetics of decay of the photostationary state of acidic iron-TH(+) solutions on solvent anions and initial concentrations of solutes has been measured and correlated with rates of elementary reactions. Sensitization increases the photostationary concentration of leucothiazine. GRA

N77-24629# Federal Railroad Administration, Washington, D. C. Office of Research and Development.
FUEL EFFICIENCY IMPROVEMENT IN RAIL FREIGHT TRANSPORTATION: MULTIPLE UNIT THROTTLE CONTROL TO CONSERVE FUEL Interim Report
Marilynne E. Jacobs Dec. 1976 31 p
(PB-262470/8; FRA/ORD-76-297) Avail: NTIS HC A02/MF A01 CSCL 13F

From the results of the tests performed on the Kansas City Southern in regular freight service, significant fuel savings were realized by using a semi-automatic throttle control device or fuel saver system to take one or more units of the locomotive consist off line when the available power and tractive effort exceeded the demand. This procedure effectively lowered the horsepower per ton ratio of the train and decreased the rate of fuel consumption. GRA

N77-24630# North Carolina Univ., Chapel Hill. Materials Research Center.
FUEL CELLS AND SOLID ELECTROLYTES Final Report, 1 Jun. 1975 - 30 Sep. 1976
Thomas J. Meyer, Royce W. Murray, Sang-Il Choi, and Thomas L. Isenhour 30 Oct. 1976 142 p refs
(Grant DAHC04-75-G-0144; ARPA Order 3005)
(AD-A033782; ARO-13067.1-A-C) Avail: NTIS HC A07/MF A01 CSCL 07/4

This report recounts results on four diverse topics: (1) homogeneous catalysis of net electrochemical reactions as applied to fuel cells; (2) electrocatalysis: application of X-ray photoelectron spectroscopy to surface composition of electrode materials; (3) theoretical investigation of solid electrolytes; and (4) application of machine decisions to failure analysis. Author (GRA)

N77-24631# Temple, Barker and Sloane, Inc., Wellesley Hills, Mass.

STUDY OF THE ELECTRIC UTILITY INDUSTRY DEMAND, COSTS, AND RATES

Jul. 1976 402 p refs

(Contract DI-14-01-0001-1899)

(PB-262843/6; FEA/D-76/289) Avail: NTIS HC A18/MF A01 CSCL 05C

Trends in the demand and costs for the electric utility industry are documented. The potential benefits of a shift to alternative rate structures that might help reshape the patterns of demand growth are examined. GRA

N77-24632# American Univ., Washington, D.C.

RESEARCH ON ELECTROCHEMICAL ENERGY CONVERSION SYSTEMS Final Technical Report, 1 Jul. 1975 - 30 Jun. 1976

Alayne A. Adams and Robert T. Foley Jul. 1976 34 p refs

(Contract DAAG53-76-C-0001; DA Proj. 1T1-61102-A-34A)

(AD-A034454) Avail: NTIS HC A03/MF A01 CSCL 07/4

The project on electrochemical energy conversion system has involved two tasks: the determination of the electrochemical behavior of low molecular weight hydrocarbons and alcohols as well as other possible fuels in aqueous trifluoromethanesulfonic acid and the examination of the electro-chemical interaction of fuel cell reactants with platinum surfaces in aqueous trifluoromethanesulfonic acid. The order of reactivity for low molecular weight alkanes was determined to be C3H8 greater than C2H6 greater than n-C4H10 greater than CH4 in trifluoromethanesulfonic acid monohydrate. The same reaction order had been established previously for low molecular weight alkanes in inorganic acids such as HF, H2SO4, and H3PO4. In the case of each alkane the electrochemical activity in the sulfonic acid was significantly greater than that in phosphoric acid under the same conditions. The electrooxidation of each alkane was evaluated over the temperature range from 95 C to 135 C. The experimental data collected during this reporting period confirm the previous finding that trifluoromethanesulfonic acid monohydrate represents an improved electrolyte for the hydrocarbon-air fuel cell.

Author (GRA)

N77-24633# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Nuclear and Alternative Energy Systems.

REPORT OF THE NATIONAL RESEARCH COUNCIL COMMITTEE ON NUCLEAR AND ALTERNATIVE ENERGY SYSTEMS

21 Jan. 1977 60 p

(Contract EX-76-C-10-3784)

(PB-263595/1) Avail: NTIS HC A04/MF A01 CSCL 18I

The nation's energy future was studied with special consideration of the role of nuclear power in the context of alternative energy systems. Appropriate roles of nuclear and alternative energy systems in the nation's energy future, with a focus on the period between 1985 and 2010, are described. Energy conservation and demand, supply and delivery systems, risks and impacts of various delivery and end-use systems, and alternative future energy scenarios are considered. GRA

N77-24634# General Electric Co., Santa Barbara, Calif. Center for Advanced Studies.

ROLE OF THE HEAT STORAGE WELL FUTURE U.S. ENERGY SYSTEMS

Charles F. Meyer, Walter Hausz, Bonnie L. Ayres, and Helen M. Ingram Sep. 1976 188 p refs

(Contracts DI-14-31-0001-4210; DI-14-31-0001-5223)

(PB-263480/6; GE76TMP-27; W77-04145;

OWRT-C-5205(4210)(5)) Avail: NTIS HC A09/MF A01 CSCL 10A

Energy to be conserved is principally that now wasted in generating electricity and in burning fossil fuels for space heating. Results of a study of technical, economic, institutional, environmental, and legal aspects of implementation are reported. GRA

N77-24635# Oklahoma Univ., Norman. Science and Public Policy Program.

OUR ENERGY FUTURE: THE ROLE OF RESEARCH, DEVELOPMENT, AND DEMONSTRATION IN REACHING A NATIONAL CONSENSUS ON ENERGY SUPPLY

Don E. Kash, Michael D. Devine, James B. Freim, Martha W. Gilliland, and Robert W. Rycroft 1976 509 p refs

(Grant NSF SIA-74-17866)

(PB-263761/9; NSF/RA-760158) Avail: NTIS HC A22/MF A01 CSCL 10A

The role of research, development, and demonstration (RD and D) in increasing the supply of energy from the domestic resources of the United States is analyzed. Part 1 describes the context of the study--the nature of the problem, the research team's conception of RD and D, and the institutions that conduct and use RD and D. Part 2 delineates constraints on increased energy supplies from domestic resources and identifies five-year RD and D efforts that can contibute to resolving those constraints. Part 3 present recommendations for priority RD and D funding and procedures for assuring that the RD and D efforts contribute as much as possible to removing the constraints on supply. GRA

N77-24636# Bureau of Mines, Washington, D.C. Div. of Interfuels Studies.

FUELS AND ENERGY DATA: UNITED STATES BY STATES AND CENSUS DIVISIONS, 1973

Lulie H. Crump Dec. 1976 121 p refs

(PB-262362/7; BM-IC-8722) Avail: NTIS HC A06/MF A01 CSCL 21D

Salient information on reserves, production, and consumption of fuels and energy by State is summarized. Reserve and production data are shown for each of the fossil fuels (coal, crude oil, natural gas liquids, and natural gas) and for uranium. The consumption data of each of the major consuming sectors (household-commercial, industrial, transportation, electric power, and miscellaneous) are broken down by energy source (coal, petroleum, natural gas, hydropower, and nuclear). In addition, total energy consumption in the Nation in 1973 is compared with consumption in 1972 and 1974. GRA

N77-24643# Argonne National Lab., Ill.

ATMOSPHERIC IMPACTS OF EVAPORATIVE COOLING SYSTEMS

J. E. Carson Oct. 1976 48 p refs

(Contract W-31-109-eng-38)

(ANL/ES-53) Avail: NTIS HC A03/MF A01

Known effects of various power plant cooling systems on the atmosphere are reviewed. Evaporative cooling systems create (at least for heat release rates comparable to those of two unit nuclear generating stations) atmospheric changes. For an isolated site such as required for a nuclear power plant, these changes are rather small and local, and usually environmentally acceptable. However, these effects may not remain small as the number of reactors on a given site increases. A critical heat load for a specific site must exist which, if exceeded, can create its own weather patterns, possibly even rain, snow, severe thunderstorms, and tornadoes. Field data are required for the development of mathematical models which can be used to forecast the extent and frequency of the atmospheric effects of a particular heat dissipation system at a particular site. ERA

N77-24665# Monsanto Research Corp., Dayton, Ohio. Dayton Lab.

PCB EMISSIONS FROM STATIONARY SOURCES: A THEORETICAL STUDY Final Report

Herman Knieriem, Jr. Oct. 1976 43 p refs

(Contract EPA-68-02-1320)

(PB-262850/1; MRC-DA-577; EPA-600/7-76-028) Avail: NTIS HC A03/MF A01 CSCL 07A

The theoretical assessment concluded that: (1) PCB (polychlorinated biphenyl) emissions are more likely from higher-chlorine content coal or residual oil combustion than from refined oil or natural gas; (2) PCB isomers with four or more chlorine atoms per molecule are more of an environmental hazard than those with three or less; (3) the probability of forming PCB isomers

with four or more atoms of chlorine per molecule during combustion is restricted by the short residence times and low concentrations of chlorine available in many fossil fuels; (4) the amount of PCB emissions, if any, may be related to polynuclear aromatic hydrocarbon emissions; (5) based on the above, inefficient combustion control is more likely to produce PCB emissions than optimum conditions; and (6) the highest priority for field sampling and analysis of PCB from combustion sources should be for small- and medium-sized, hand- and underfeed-stoked coal furnaces. GRA

N77-24667# Applied Urbanetics, Inc., Washington, D.C.
VAPOR RECOVERY ANALYSIS
28 Nov. 1976 158 p refs
(Contract FEA-CO-06-60435)
(PB-262846/9; FEA/H-77/030) Avail: NTIS
HC A08/MF A01 CSCL 05C

Vapor recovery system (VRS) regulations affecting the retail service station establishments are developed in two stages: Stage 1 VRS refers to the capture of hydrocarbon vapors displaced from underground tanks at the time of bulk product delivery and Stage 2 VRS refers to the capture of vapors displaced from automobile tanks at the time of refueling. Attention is focused primarily on Stage 2 VRS, but a brief discussion of Stage 1 VRS is given. GRA

N77-24671# Research Corp. of New England, Wethersfield, Conn. Environmental Technology Div.
DEVELOPMENT OF PROCEDURES FOR THE MEASUREMENT OF FUGITIVE EMISSIONS Final Report, Jul. 1974 - Jun. 1975
P. W. Kalika, R. E. Kenson, and P. T. Bartlett Dec. 1976 134 p refs
(Contract EPA-68-02-1815)
(PB-263992/0; EPA-600/2-76-284) Avail: NTIS
HC A07/MF A01 CSCL 13B

The development included: identification of the sources of fugitive emissions, evaluation of sampling strategies, preparation of field test procedures, field evaluation of one fugitive emissions field test procedure, and issuance of technical manuals for each sampling strategy. Eighteen industries/processes which might have potentially significant fugitive emissions were identified, selected from all the industries/processes studied and based on the potential of their fugitive emissions to be hazardous and to have high fugitive emissions rates. The eighteen industries/processes were grouped by category metallurgical processing, energy/fuels processing, chemical products, rock products, and agricultural operations. GRA

N77-24672# Olson Labs., Inc., Anaheim, Calif.
EFFECT OF AUTOMOTIVE PARTS ON VEHICLE AND ENGINE EMISSIONS. PHASE 1: ORIGINAL EQUIPMENT Final Report
Richard R. Carlson Dec. 1976 260 p refs
(Contract EPA-68-01-1957)
(PB-264057/1; EPA-340/2-76-001) Avail: NTIS
HC A12/MF A01 CSCL 13B

The primary objective of this study was to identify engine and emission control system components which are critical in causing excessive emissions of one or more regulated pollutants. The emission criticality of original equipment installed by the engine or vehicle manufacturers was investigated. A computer model was developed to calculate and rank order an index representing the criticality of each component type. Separate rankings were developed for HC, CO, NOx and smoke (heavy duty diesel engines) emissions and for vehicles equipped with catalysts and those without. The index for each component type was calculated from the product of four factors representing the emission increase resulting from a component failure, the probability of component failure, the probability of component repair, and the sales volume of the component. GRA

N77-24673# Clemson Univ., S.C. Water Resources Research Inst.
EFFECTS OF THERMAL POLLUTION ON CERTAIN AQUATIC INVERTEBRATES Final Report
Averett S. Tombes and Byron R. Ingram Aug. 1976 66 p refs
(Contracts DI-14-31-001-3541; DI-14-34-0001-6042)
(PB-263488/9; WRRI-65; W77-04144; OWRT-A-027-SC(2))
Avail: NTIS HC A04/MF A01 CSCL 13B

Ecological and ultrastructural data are presented on selected macroinvertebrates from Lake Keowee which receives heated effluent from three nuclear reactors. The ecological data show the effects of depth, station, location and season on density, diversity and taxonomic composition of the collected benthos. Abundance and diversity of invertebrates were lower at the discharge canal and its surrounding areas than in the intake canal and control areas. Composition of the substrate and temperature of the environment have decided influences on the fauna of this relatively young lake. The subtle biological effects of a temperature change were determined by examining ultrastructurally the nerve cells of the frontal ganglion in Chaoborus punctipennis. GRA

N77-24674# Institute of Gas Technology, Chicago, Ill.
SURVEY OF EMISSIONS CONTROL AND COMBUSTION EQUIPMENT DATA IN INDUSTRIAL PROCESS HEATING Final Report, Jun. 1974 - Nov. 1975
Peter A. Ketels, John D. Nesbitt, and R. Don Oberle Oct. 1976 134 p refs
(Contract EPA-68-02-1821)
(PB-263453/3; EPA-600/7-76-022) Avail: NTIS
HC A07/MF A01 CSCL 13B

The interactions between present and potential energy conservation measures and emission programs in various industries were investigated. Where energy conservation goals conflicted with emission control goals, the problems were assessed. Based on these assessments, research and development programs were recommended to solve each industry's problems. The study was limited both to processes in which heat was obtained through the direct combustion of fossil fuels, and to emissions that are affected by combustion itself. GRA

N77-24709# Ohio State Univ. Research Foundation, Columbus. Inst. of Polar Studies.
A FRAMEWORK FOR ASSESSING ENVIRONMENTAL IMPACTS OF POSSIBLE ANTARCTIC MINERAL DEVELOPMENT, PART 1 Final Report
David H. Elliot Jan. 1977 175 p refs
(Contract DOS-1753-600100)
(PB-262750/3; IPS-M-119-Pt-1) Avail: NTIS
HC A08/MF A01 CSCL 08I

The physical environment of Antarctica is described. Hypothetical resources were considered to develop an environmental assessment. Unavoidable impacts on the on-shore and off-shore environments resulting from exploration and exploitation are identified and discussed. Alternatives and special provisions are discussed and recommendations presented. GRA

N77-24711# *Harza Engineering Co., Chicago, Ill.*
COMPREHENSIVE GROUND CONTROL STUDY OF A MECHANIZED LONGWALL OPERATION. VOLUME 2: SPECIAL REPORTS. 1: PHYSICAL PROPERTIES OF COAL AND COAL MEASURE ROCKS. 2: BEARING CAPACITY OF ROOF AND FLOOR ROCKS. 3: RESPONSE OF BOREHOLE PRESSURE CELLS. 4: INSTALLATION OF SUBSURFACE INSTRUMENTATION Final Report
30 Jan. 1976 270 p
(Contract DI-BM-H0230012)
(PB-262476/5; BM-OFR-5-77-Vol-2) Avail: NTIS
HC A12/MF A01 CSCL 08I

Strata control measurements on an operating longwall are described from which engineering design values for structural parameters such as convergence in the face area and support

load density, as function of the rate of mining and the strata properties can be extracted. Volume 11 contains four special reports: physical properties of coal and coal measure rocks, bearing capacity of roof and floor rocks, response of borehole pressure cells, and installation of subsurface instrumentation. GRA

N77-24714# Systems Control, Inc., Palo Alto, Calif.
THE ANALYSIS OF SUBSIDENCE ASSOCIATED WITH GEOTHERMAL DEVELOPMENT. VOLUME 1: HANDBOOK
R. W. Atherton, E. J. Finnemore, and M. L. Gilliam Sep. 1976 287 p refs 3 Vol.
(Grant NSF AER-75-17298)
(PB-263692/6; NSF/RA-760414-Vol-1) Avail: NTIS HC A13/MF A01 CSCL 08I

The state of knowledge of subsidence associated with geothermal development is evaluated and preliminary methods to assess the potential of land subsidence for any specific geothermal site are provided. The results are presented in three volumes. Volume 1 is designed to serve as a concise reference, a handbook, for the evaluation of the potential for land subsidence from the development of geothermal resources. GRA

N77-24715# Systems Control, Inc., Palo Alto, Calif.
THE ANALYSIS OF SUBSIDENCE ASSOCIATED WITH GEOTHERMAL DEVELOPMENT. VOLUME 2: RESEARCH REPORT
R. W. Atherton, E. J. Finnemore, and M. L. Gilliam Sep. 1976 668 p refs 3 Vol.
(Grant NSF AER-75-17298)
(PB-263693/4; NSF/RA-760415-Vol-2) Avail: NTIS HC A99/MF A01 CSCL 08I

A compendium of research results on subsidence and geothermal energy is provided as well as backup information to the subsidence handbook. Topics treated included; (1) the fundamentals of geothermics; (2) the geology and physical processes of subsidence; (3) a survey of subsidence and reservoir models; (4) and methods for evaluating subsidence potential via analogy or analysis methods. GRA

N77-24716# Systems Control, Inc., Palo Alto, Calif.
THE ANALYSIS OF SUBSIDENCE ASSOCIATED WITH GEOTHERMAL DEVELOPMENT. VOLUME 3: INFORMATION BANK
M. L. Gilliam, B. E. Kenks, and R. W. Atherton Sep. 1976 185 p refs 3 Vol.
(Grant NSF AER-75-17298)
(PB-263694/2; NSF/RA-760416-Vol-3) Avail: NTIS HC A09/MF A01 CSCL 08I

The following are included: (1) a glossary of specialized terms as they are used in geothermal subsidence and directly related topic areas; (2) a listing of institutions and organizations possessing specialized collections of documents related to geothermal subsidence; (3) a keyword index of the documents obtained; and (4) an alphabetical listing of more than 1000 documents collected and catalogued during the study. GRA

N77-24729# Brookhaven National Lab., Upton, N.Y.
FUTURE OIL SUPPLY TO THE NORTHEAST UNITED STATES
H. Bronheim Jun. 1976 87 p refs
(Contract E(30-1)-16)
(BNL-50557) Avail: NTIS HC A05/MF A01

Under various assumptions of total U.S. reserves of oil (discovered and undiscovered) coupled to alternate schedules of national resource development, projections of crude oil production were made for the years 1985 and 2000. The projections indicate that even under optimistic conditions crude oil production will be declining in the post-1985 period, if not earlier. The scenarios consistently indicate that the Northeast's regional share will be heavily constrained by 1985, and rapidly declining thereafter. ERA

N77-24997# Brookhaven National Lab., Upton, N.Y.
STUDY TO ASSESS THE APPLICATION OF SHADOW PRICING TECHNIQUES TO NATIONAL ENERGY RESOURCE PLANNING Final Report, Year 1
Jun. 1976 158 p refs
(Contract E(30-1)-16; Grant NSF SIA-74-02555-01)
(BNL-50537) Avail: NTIS HC A08/MF A01

The dynamic energy system optimization model analyzes optimal allocation of exhaustible energy resources over time. It is a multi-period representation of the nation's energy supply and utilization system that incorporates cost and time elements associated with new capital facilities, the discount rate, internal selection of new energy technologies, and internal determination of primary energy resource allocation over time. Applications of a single-period energy model demonstrate obtaining first estimates benefit/cost ratios for federal R and D investment in the high-Btu coal-gasification technology, and evaluating the economic impact of a sulfur dioxide emission constraint in certain end uses. ERA

N77-24998# Brookhaven National Lab., Upton, N.Y. Economic Analysis Div.
ECONOMY-WIDE IMPACTS OF INTERFUEL SUBSTITUTION: SUBSTITUTION OF ELECTRICITY FOR IMPORTED OIL
R. G. Tessmer, Jr. and J. Lukachinski Jun. 1976 63 p refs
(Contract E(30-1)-16)
(BNL-50538) Avail: NTIS HC A04/MF A01

An energy input-output model is applied to analysis of the long-run effects (to 1985) of higher oil prices in the U.S. economy. Aspects investigated are the effects of sustained, higher international oil prices, and the effects of substituting domestic-coal-produced electricity for high-priced foreign oil. Variables examined include capital investment, personal consumption expenditures, exports and imports, labor force, and energy production. ERA

N77-24999# Brookhaven National Lab., Upton, N.Y. Economic Analysis Div.
EFFECTS OF ALTERNATIVE OIL STOCKPILING PROGRAMS ON THE US ECONOMY, 1976-1979 Final Results
R. G. Tessmer, Jr. and D. J. Behling, Jr. Jun. 1976 48 p refs
(Contract E(30-1)-16)
(BNL-50541) Avail: NTIS HC A03/MF A01

Application of Brookhaven's energy input-output model is demonstrated by analyzing economy-wide effects of an oil stockpile program. The model is used to estimate the 1976-79 inter-industry output, employment, capital, and energy substitution effects of 730- and 4,380-barrel stockpiles. Two policy variables (the type of stockpile facility and the method of financing) and one assumption (balance of payments effects) are examined ERA

N77-25010# Los Alamos Scientific Lab., N. Mex.
SUMMARY DESCRIPTION OF THE BOOM1 MODEL
A. Ford Jun. 1976 14 p refs
(Contract W-7405-eng-36)
(LA-6424-MS) Avail: NTIS HC A02/MF A01

The principal features of a computer program modeling boom town impacts are described. Model outputs include population, permanent and mobile homes, public facilities and municipal debt, local property tax rate and state transfer payments, construction work force, construction productivity, and retail and services facilities. The model can be used to simulate the behavior of these variables over a time span covering the pre-boom, construction, operation, and retirement phases of an energy project. The model runs may be interrupted in any year to simulate the effectiveness of assistance measures that have been proposed by national, state, local, and energy company officials. ERA

N77-25011# Aerospace Corp., Germantown, Md.
ENERGY RECOVERY FROM MUNICIPAL SOLID WASTE, AN ENVIRONMENTAL AND SAFETY MINI-OVERVIEW SURVEY

R. L. Johnson Jun. 1976 181 p refs
(Contract E(04-3)-1101)
(ATR-76(7518)-7) Avail: NTIS HC A09/MF A01

The environmental and safety aspects of processing municipal solid wastes to recover energy and materials are reviewed in some detail. The state of the art in energy recovery, energy potential for the near and long-term, and constraints to commercialization are discussed. Under the environmental and safety aspects the state of the art, need for research and development, and need for coordination among federal agencies and private industry are considered. Eleven principal types of refuse-to-energy processes are described, and a projected energy balance is derived for each process. ERA

N77-25014# Pennsylvania Univ., Philadelphia. Wharton School of Finance and Commerce.

IMPACT OF A SUBURBAN RAPID TRANSIT LINE OF FUEL CONSUMPTION AND COST FOR THE JOURNEY-TO-WORK. ANALYSIS OF THE PHILADELPHIA-LINDENWOLD HIGH-SPEED LINE Final Report

David E. Boyce, Khanh Nguyen, Thierry Noyelle, and Kent Webb Dec. 1975 74 p refs
(Contract DI-14-01-0001-1700)
(PB-263048/1; FEA/D-77/023) Avail: NTIS HC A04/MF A01 CSCL 13B

Two analyses of the Philadelphia-Lindenwold High-Speed Line are presented which are potentially useful for evaluating the potential of similar transit systems for conserving energy. First, the electrical energy consumption, fuel consumption and fuel cost per passenger-mile and car-mile are estimated from operating data, and compared with estimates for auto and bus modes. Second, these estimates are applied to the 1970 census journey-to-work data to estimate person-miles of travel, fuel consumption and fuel cost by mode, origin and destination for an actual commuting situation. GRA

N77-25018# Transportation Research Board, Washington, D. C.

TRANSPORTATION PROGRAMMING, ECONOMIC ANALYSIS, AND EVALUATION OF ENERGY CONSTRAINTS

Greig W. Harvey, Elizabeth A. Deakin, Ronald R. Knox, Theodore K. Martin, and William J. Yuskus 1976 74 p refs
(PB-262878/2; TRB/TRR-599; ISBN-0-309-02568-0) Avail: NTIS HC A04/MF A01 CSCL 13B

State and local roles in transportation control planning, programming highway improvements in new funding environment, highway investment analysis package, improving the process of programming transportation investments, and gasoline consumption in urban traffic are analyzed. Energy analysis for urban transportation systems, a use of dis-aggregate travel demand models to analyze car pooling policy incentives, new technique for evaluating urban traffic energy consumption and emissions, and energy conservation potential of urban public transit were calculated. GRA

N77-25021# Lehigh Univ., Bethlehem, Pa. Div. of Urban Studies.

DESIGN OF MUNICIPAL SERVICES IN SUPPORT OF HIGH RISE OFFICE BUILDINGS

Leonard I. Ruchelman and Charles N. Brownstein May 1975 428 p refs
(PB-262532/5; NSF/RA/S-75-101) Avail: NTIS HC A19/MF A01 CSCL 13B

Transporting large numbers of people in and out of high density districts, meeting the growing demand for sewage, water and energy services, assuring the visual and functional compatibility of large structures with the environment, and delivering effective police and fire protection were examined in cities where extensive tall building development is manifest. Focusing on two highrise office building projects in New York City--the Pan Am Building and the World Trade Center--how the decision-making contributes or fails to contribute to environmental concerns is discussed. GRA

N77-25027# Research Triangle Inst., Research Triangle Park, N. C.

RANN UTILIZATION EXPERIENCE (CASE STUDIES 32 THROUGH 41) Final Report

T. M. Burger and M. F. Massoglia Nov. 1976 328 p refs 2 Vol.
(Contract NSF C-76-17165)
(PB-263683/5; NSF/RA-760413) Avail: NTIS HC A15/MF A01 CSCL 05B

Ten Research Applied to National Needs (RANN) projects are reported. Subject areas include: (1) creating and evaluating an experimental industry-university furniture R and D applications institute; (2) innovation centers; (3) the less cash/less check society: an indepth technology assessment; (4) urban technology system; (5) energy absorption characteristics of structural systems subjected to earthquakes excitation; (6) metromex; (7) the Texas Energy Advisory Council; (8) tertiary oil recovery; (9) assessment of a new textile technology; and (10) automated bending system for the fabrication of ship frames. GRA

N77-25086*# *National Aeronautics and Space Administration.* Langley Research Center, Langley Station, Va.

STATIC AND WIND-ON TESTS OF AN UPPER-SURFACE-BLOWN JET-FLAP NOZZLE ARRANGEMENT FOR USE ON THE QUIET CLEAN SHORT-HAUL EXPERIMENTAL ENGINE (QCSEE)

Arthur E. Phelps, III Jun. 1977 44 p refs
(Da Proj. 1L1-61102-AH-45)
(NASA-TN-D-8476; L-11421) Avail: NTIS HC A03/MF A01 CSCL 01A

The internal aerodynamic performance, the static turning characteristics, and the forward-speed characteristics of two 1/12-scale upper surface-blown jet-flap exhaust-nozzle arrangements designed for use on the Quiet Clean Short-Haul Experimental Engine (QCSEE) were investigated. The nozzles were equipped with interchangeable area-control side doors in the aft sidewalls of the nozzle so that the effective nozzle area could be varied over a wide range. A simulated wing was used to evaluate installation losses for the nozzles. A smoothly curved flap was attached to the trailing edge of the simulated wing to allow an evaluation of the static turning characteristics of the nozzle arrangement. Forward-speed effects on the jet turning characteristics of the QCSEE nozzles were evaluated by mounting a single engine on a semispan wing designed to be representative of a four-engine STOL transport configuration. Author

N77-25280# Midwest Research Inst., Kansas City, Mo.

COMPREHENSIVE REPORT AND INVESTIGATION ON HELIUM USES Final Report, period ending 31 Jan. 1977

31 Jan. 1977 147 p refs
(Contract DI-14-09-0060-5152)
(PB-263515/9; BM-OFR-25-77) Avail: NTIS HC A07/MF A01 CSCL 07B

Sales of helium in 1975 were found to be 601 million cubic feet (MMcf) compared with 907 MMcf for 1976. The use categories for helium remained the same, although there was a rearrangement of the percentage used in each of 12 use categories. Cryogenic applications accounted for almost 35 percent of the total volume used followed by pressurizing and welding at 16 percent each. Synthetic breathing mixtures was the fourth highest use category accounting for 9 percent. The study forecasts that the total volume of helium to be used in the United States in 1977 will increase to 710 MMcf, 957 MMcf by 1985, and 1,315 MMcf by the year 2000. GRA

N77-25345*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THERMAL STABILITY OF SOME AIRCRAFT TURBINE FUELS DERIVED FROM OIL SHALE AND COAL

Thaine W. Reynolds Washington Jun. 1977 33 p refs
(NASA-TM-X-3551; E-9070) Avail: NTIS HC A03/MF A01 CSCL 21D

Thermal stability breakpoint temperatures are shown for 32 jet fuels prepared from oil shale and coal syncrudes by various degrees of hydrogenation. Low severity hydrotreated shale oils,

An assessment of the potential of active solar energy systems for buildings in California is summarized. The technology used for solar heating, cooling, and water heating in buildings is discussed. The major California weather zones and the solar with nitrogen contents of 0.1 to 0.24 weight percent, had breakpoint temperatures in the 477 to 505 K (400 to 450 F) range. Higher severity treatment, lowering nitrogen levels to 0.008 to 0.017 weight percent, resulted in breakpoint temperatures in the 505 to 533 K (450 to 500 F) range. Coal derived fuels showed generally increasing breakpoint temperatures with increasing weight percent hydrogen, fuels below 13 weight percent hydrogen having breakpoints below 533 K (500 F). Comparisons are shown with similar literature data. Author

N77-25447# Edgerton, Germeshausen and Grier, Inc., Salem, Mass. Electronic Components Div.
REPETITIVE SERIES INTERRUPTER II Triannual Report, 26 Jan. - 23 May 1976
David V. Turnquist Dec. 1976 16 p refs
(Contract DAAB07-76-C-1301)
(AD-A035267; ECOM-76-1301-1; Rept-1) Avail: NTIS HC A02/MF A01 CSCL 09/1

The objective of the effort is to obtain an improved exploratory development model of the 15 kilovolts series interrupter. Designs of experimental devices, based on hydrogen thyratron techniques, are described. A test circuit has been constructed, and the test results obtained to date are discussed. GRA

N77-25485 British Library Lending Div., Boston Spa (England).
DETERMINATION OF LOW ACTIVITIES OF U-Ra-SERIES ELEMENTS BY A LIQUID-SCINTILLATION SPECTROMETER
H. Prochazka and R. Jilek Aug. 1976 9 p refs Transl. into ENGLISH from Jaderna Energie (Prague), v. 17, no. 4, 1971 p 117-120
(BLL-SMRE-Trans-6562-(8313.4)) Avail: British Library Lending Div., Boston Spa, Engl.

The use of a liquid scintillation spectrometer for the determination of naturally occurring uranium, radium, lead, and polonium in aqueous solutions and in biological materials is described. The method of simple preparation of the samples is presented as a practical example of the quantitative and qualitative evaluation of the results of measurements and generally valid principles of analysis. The method is suitable both for the investigation of the pollution of waste waters and for establishing the activity of the ash of biological tissues. Author

N77-25551# Battelle Columbus Labs., Ohio.
EVALUATION OF METHODS FOR MEASURING AND CONTROLLING HYDROCARBON EMISSIONS FROM PETROLEUM STORAGE TANKS Final Report
D. A. Ball, A. A. Putnam, and R. G. Luce Nov. 1976 100 p refs
(Contract EPA-68-01-3159)
(PB-262789/1; EPA-450/3-76-036) Avail: NTIS HC A05/MF A01 CSCL 13B

The API (American Petroleum Institute) emissions test procedures were found to be technically sound although they require extensive test times to obtain significant results. Little change was seen to increase accuracy or reduce the test time of these procedures. Several new test procedures were analyzed and one was felt to have promise of achieving accurate emissions results in substantially reduced test times. GRA

N77-25612*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROGRAM DEFINITION FOR THE DEVELOPMENT OF GEOTHERMAL ENERGY. VOLUME 1: BACKGROUND AND PROGRAM DEFINITION SUMMARY
29 Aug. 1975 59 p refs Sponsored in part by ERDA 3 Vol.
(Contract NAS7-100)
(NASA-CR-15322; PB-263833/6; NSF/RA/N-75-338A-Vol-1; JPL-5040-6-Vol-1) Avail: NTIS HC A04/MF A01; also avail. in set of 3 reports HC E10, PB-263832-SET CSCL 08I

Federal Government actions proposed to facilitate a significant acceleration in the commercial utilization of the nation's valuable geothermal energy resources, in an environmentally acceptable manner, are reported. The utilization level that might be achieved by 1985 and beyond, as a result of an effective Federal Government program to facilitate industrial development of geothermal energy, is projected. Existing barriers to that development are discussed, and the three basic steps to development are presented. Development strategy adopted and detailed requirements for growth are included. GRA

N77-25613*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROGRAM DEFINITION FOR THE DEVELOPMENT OF GEOTHERMAL ENERGY. VOLUME 2: PROGRAM DEFINITION DEVELOPMENT RATIONALE AND SUBPROGRAM DESCRIPTIONS
29 Aug. 1975 250 p refs Sponsored in part by ERDA 3 Vol.
(Contract NAS7-100)
(NASA-CR-153222; PB-263834/4;
NSF/RA/N-75-338B-Vol-2; JPL-5040-6-Vol-2) Avail: NTIS HC A11/MF A01; also avail. in set of 3 reports HC E10, PB-263832-SET CSCL 08I

The objectives and the goal of the program are defined, and the expected sequence for commercialization of various resource types is presented. Needed technology demonstrations are outlined, and the major problems associated with obtaining rapid growth in utilization of these resources are identified. The scope of actions readily available to the government are specified. Basic strategy for program development as an effort to get the private sector moving, and to sustain it until it gathers sufficient momentum to become self-sustaining is outlined. The overall subprogram descriptions and the detailed rationale for each of the recommended actions is provided. Author

N77-25614*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROGRAM DEFINITION FOR THE DEVELOPMENT OF GEOTHERMAL ENERGY. VOLUME 3: APPENDIXES
29 Aug. 1975 411 p Sponsored in part by ERDA 3 Vol.
(Contract NAS7-100)
(NASA-CR-153223; PB-263835/1;
NSF/RA/N-75-338C-Vol-3-App; JPL-5040-6-Vol-3) Avail: NTIS HC A18/MF A01; also avail. in set of 3 reports HC E10, PB-263832-SET CSCL 08I

The following appendixes are provided; Implications of the 1985 Goal and Updated Sensitivity Analysis; Geothermal Development Timelines; Leasing and Exploration; Research and Development; Electric Utilities; Nonelectric Geothermal Market; Geopressured Resource Research and Development; Community Planning; Summary of ERDA Patent Policy Relevant to Geothermal Energy; Factors Affecting the Development of Known Geothermal Prospects; Environmental Laws and Regulations; An Elementary Treatment of Economics of Geothermal Power Production; Conversion Cycle Analysis; Projection of Attainable Geothermal Energy Development and Use; and Geothermal Energy Research, Development, and Demonstration Act of 1974. GRA

N77-25623# Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
DIPOLE-DIPOLE RESISTIVITY SURVEYS, ROOSEVELT HOT SPRINGS KGRA, VOLUME 2 Final Report
S. H. Ward and W. R. Sill Jun. 1976 52 p refs
(Grant NSF GI-43741)
(PB-264897/0; NSF/RA-760369) Avail: NTIS HC A04/MF A01 CSCL 08I

Three different dipole spacings were used; 99 km of traverse line were surveyed with 100 m dipoles, 50 km with 300 m dipoles, and 44 km with 1 km dipoles. The resistivity surveys delineated regions of low resistivity associated with fracturing, brines, high temperatures, and clay alteration. The resistivity of rocks that are typical of hydrothermal environments is due to two main conduction mechanisms: electrolytic conduction and porosity of rocks. GRA

N77-25625# Mathtech, Inc., Princeton, N. J.
EVALUATION OF CURRENT SURFACE COAL MINING OVERBURDEN HANDLING TECHNIQUES AND RECLAMATION PRACTICES Final Report
Frank Cook and William Kelly 24 Dec. 1976 320 p refs
(Contract DI-BM-S0144081)
(PB-264111/6; BM-OFR-28-77) Avail: NTIS HC A14/MF A01 CSCL 08I

An evaluation of mining and reclamation practices at 159 randomly sampled surface coal mines in the United States was conducted. Operating procedures for dragline stripping of single and multiple seams, surface mining of lignite, multicut and multiseam haulback mining on steep slopes, mountaintop removal, and surface mining in swampy or deeply glaciated areas are discussed. Specific candidate research projects are noted. GRA

N77-25631*# Lockheed Electronics Co., Houston, Tex. Systems and Services Div.
PROGRAM DOCUMENT FOR ENERGY SYSTEMS OPTIMIZATION PROGRAM 2 (ESOP2). VOLUME 1: ENGINEERING MANUAL
R. G. Hamil and S. L. Ferden Mar. 1977 53 p refs
(Contract NAS9-15200)
(NASA-CR-151422; LEC-9764-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 10C

The Energy Systems Optimization Program, which is used to provide analyses of Modular Integrated Utility Systems (MIUS), is discussed. Modifications to the input format to allow modular inputs in specified blocks of data are described. An optimization feature which enables the program to search automatically for the minimum value of one parameter while varying the value of other parameters is reported. New program option flags for prime mover analyses and solar energy for space heating and domestic hot water are also covered. Author

N77-25632# Congressional Budget Office, Washington, D. C.
ENERGY RESEARCH: ALTERNATIVE STRATEGIES FOR DEVELOPMENT OF NEW ENERGY TECHNOLOGIES AND THEIR IMPLICATIONS FOR THE FEDERAL BUDGET
15 Jul. 1976 78 p refs
(Paper-10) Avail: SOD HC $1.25

Recognizing the important contribution that research can make to the solution of both short and long range energy problems, Congress has expanded and redirected Federal policies and programs in energy research, development, and demonstration (R,D,&D). It has directed the Energy Research and Development Administration (ERDA) to design a national energy research and development plan and a program for implementing it. Author

N77-25634# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY AND RESOURCE PLANNING GROUP Annual Report, 1976
B. Rubin 13 Sep. 1976 33 p refs
(Contract W-7405-eng-48)
(UCRL-50029-76) Avail: NTIS HC A03/MF A01

The principal mission of the Energy and Resource Planning Group is to identify and evaluate the potential benefits of new energy technologies for the nation. The Stanford Research Institute Energy Model was used to help determine the effects of specific new energy technologies, and because the synthetic fuels produced by some of these new technologies will compete directly with domestic and imported oil and gas, the world crude oil supply and the projected costs of synthetic fuels were studied. The study on world oil supply indicates the possibility of a temporary price break in the early 1980s due to a rapid rise in free-world oil production, a currently constrained demand, and large expenditures by oil-exporting countries. Projected costs of synthetic liquid fuels were calculated on an equivalent accounting basis, at both production and delivery-pump levels. A number of modifications and additions were made to the SRI model for the studies. ERA

N77-25635# Illinois Univ., Urbana. Center for Advanced Computation.
ENERGY ANALYSIS HANDBOOK. CAC DOCUMENT 214
C. W. Bullard, P. S. Penner, and D. A. Pilati Oct. 1976 71 p refs
(Contract EY-76-S-02-2865)
(COO-2865-1; CAC-214) Avail: NTIS HC A04/MF A01

Methods are presented for calculating the energy required, directly and indirectly, to produce all types of goods and services. Procedures for combining process analysis with input-output analysis are described. This enables the analyst to focus data acquisition cost effectively, and to achieve a specified degree of accuracy in the results. The report presents sample calculations and provides the tables and charts needed to perform most energy cost calculations, including the cost of systems for producing or conserving energy. ERA

N77-25636# Kansas State Univ., Manhattan.
PERSPECTIVES IN ENERGY: 1976
J. K. Shultis 2 Aug. 1976 429 p refs
(CES-17) Avail: NTIS HC A19/MF A01

A compilation of seventeen lectures based on presentations from summer workshops held at Kansas State University is given. Information is covered on the current status of the energy situation to alternate energy options. ERA

N77-25638# Sandia Labs., Albuquerque, N. Mex.
MAGMA ENERGY RESEARCH PROJECT, VOLUME 2, NO. 2
J. Colp, ed., J. A. Mogford, ed., and L. S. Marcrum Aug. 1976 19 p Sponsored by ERDA
(SAND-76-0264-Vol-2-No-2) Avail: NTIS HC A02/MF A01

The technological feasibility of extracting energy directly from deeply buried circulating magma sources is investigated. The project embodies the concept of a fully closed heat-exchange system inserted directly into a magma source to allow heat energy to be brought to the surface with minimal environmental impact. Accomplishments are briefly discussed for the four components of the project: source location and definition, source tapping, magma characterization and materials compatibility, and energy extraction studies. Author (ERA)

N77-25639# Los Alamos Scientific Lab., N. Mex.
LASL HOT DRY ROCK GEOTHERMAL PROJECT Progress Report, 1 Jul. 1975 - 30 Jun. 1976
A. G. Blair, comp., J. W. Tester, comp., and J. J. Mortensen, comp. Oct. 1976 238 p refs
(Contract W-7405-eng-36)
(LA-6525-PR) Avail: NTIS HC A11/MF A01

Successful drilling into hard crystalline rock was accomplished to depths of about 3 km. Hydraulic fractures in the crystalline rock with radii as large as 150 m were produced. At least 90 to 95 percent of water injected into fractured regions was recovered. A connection was established between two deep boreholes through a fractured region of hot granite for the first time. Instruments were developed to operate for several hours under the downhole conditions. The compressional and shear components of seismic signals produced by fracture extension and inflation were detected downholes. Acoustic ranging generally identified the relative positions of two boreholes at several depths. Self-potential and induced potential techniques determined vertical fracture lengths at the borehole. Pressure-flow and fluid residence time distribution studies have measured properties of the downhole system. Core sample studies provided physical and chemical data. Techniques were developed to examine reservoir performance. A geothermal power production model was formulated. Author (ERA)

N77-25640# Lockheed Missiles and Space Co., Palo Alto, Calif.
DEVELOPMENT OF PLASTIC HONEYCOMB FLAT-PLATE SOLAR COLLECTORS

K. N. Marshall, R. K. Wedel, and R. E. Dammann Apr. 1976 188 p refs
(Contract E(04-3)-1081)
(SAN-1081-76/1; LMSC-D462879) Avail: NTIS HC A09/MF A01

An analytical and experimental program was conducted to develop high performance flat plate solar collectors for use in the temperature range of 355 to 395 K using thin-film transparent plastic honeycomb. Thermal analyses showed that the efficiencies of properly designed plastic honeycomb covered collectors were substantially higher than those of comparable non-honeycomb systems. Candidate plastics were selected, and hexagonal shaped honeycombs were fabricated using Lexan, Mylar, Tedlar, and Kapton. Various honeycomb aspect ratios (L/D) between 1 and 10 were studied to determine the optimum. Full scale honeycomb collectors were constructed and tested under ambient weather conditions to determine actual performance and confirm analytical predictions. ERA

N77-25643# Maryland Univ., College Park. Dept. of Mechanical Engineering.
PROCEEDINGS OF THE SOLAR INDUSTRIAL PROCESS HEAT WORKSHOP
William R. Cherry (ERDA, Washington; D.C.), William W. Auer (ERDA, Washington, D.C.), Redfield W. Allen, and Davinder K. Anand Aug. 1976 83 p Proc. held at College Park, Md., 28-29 Jun. 1976
(Contract E(49-18)-2324)
(CONF-760655) Avail: NTIS HC A05/MF A01

Demand information obtained from energy intensive industries in the Southwest has been utilized to size solar total energy systems, individual process heat, and electrical systems. Distributed and central receiver collection systems were investigated. For the example cited, although the central receiver is more efficient, preliminary costing exercises indicate that a distributed system is more economical. ERA

N77-25647# Kaman Sciences Corp., Colorado Springs; Colo.
UNITED STATES SPECIAL FORMAT REPORT: REPORT OF THE PHOENIX CORPORATION, CITY OF COLORADO SPRINGS SOLAR HEATING PROJECT
D. M. Jardine Jun. 1976 72 p refs
(SE-4578-76/1; WA/4578-76/1) Avail: NTIS HC A04/MF A01

The development of a solar assisted heat pump system and its operating characteristics is covered. The thermal energy storage subsystem is of prime importance to the operation of the system. The performance of the underground uninsulated steel tank containing water and using the ground as an additional thermal energy storage medium to act as a heat source and heat sink for the system is reported. The type and performance of the heat pump used is covered. The use of commercially available heat transfer fluid in the collector and heat pump evaporator thermal energy transfer system to eliminate corrosion, electrolysis, boiling, and freezing within the system is presented. The system economic analysis covers the cost of backup and system operating energy as a large economic factor that must be recognized.
Author (ERA)

N77-25648# Arizona State Univ., Tempe. Coll. of Engineering and Applied Sciences.
ENERGY IN PERSPECTIVE: AN ORIENTATION CONFERENCE FOR EDUCATORS
John W. McKlveen, ed. 1976 422 p refs Proc. held at Tempe, Ariz., 7-11 Jun. 1976
(Contract E(11-1)-2937)
(CONF-760677) Avail: NTIS HC A18/MF A01

Papers on all aspects of energy were presented at the conference by experts from throughout the United States. The tours to energy installations conducted during the conference and demonstration related to energy are cited. ERA

N77-25653# Centre National de la Recherche Scientifique, Marseilles (France). Lab. d'Astronomie Spatiale.
OPTICAL STUDY OF FIXED SPHERICAL SOLAR COLLECTORS
B. Authier 1976 20 p refs In FRENCH; ENGLISH summary Submitted for publication
(LAS-PRC-76-01) Avail: NTIS HC A02/MF A01

A geometrical optics study is presented which permits a graphical representation of the radiation incident along the sagital line. It is shown that the addition of the mobile mirror element (viser) considerably increases the intercepted radiation in tropical regions. ESA

N77-25654# Missouri Univ., Columbia. Dept. of Electrical Engineering.
DEVELOPMENT OF A NEW SILICON SCHOTTKY PHOTOVOLTAIC ENERGY CONVERTER Final Report, 15 Jan. 1975 - 30 Jun. 1976
E. J. Charlson Aug. 1976 51 p refs
(Contract NSF ENG-74-02918)
(PB-262491/4; UMC-SSL-1) Avail: NTIS HC A04/MF A01 CSCL 10B

An Al/P-type silicon MOS solar cell was investigated. The structure includes a controlled thickness interfacial oxide layer between the Al and the silicon. Electrical data from a large number of different fabrication techniques are given. A detector mode current multiplication was discovered and analyzed. Polycrystalline substrates were found to yield good solar cells with approximately one-half the conversion efficiency of single crystal cells. Included are TEM micrographs of the thin film and semiconductor surfaces. Quantum efficiency measurements are also included. GRA

N77-25655# Federal Energy Administration, Washington, D. C. Office of Energy Resource Development.
TRENDS IN POWER PLANT CAPACITY AND UTILIZATION. INVENTORY OF POWER PLANTS IN THE UNITED STATES
Dec. 1976 325 p
(PB-264451/6; FEA/G-77/100) Avail: NTIS HC A14/MF A01 CSCL 10B

An inventory of existing and projected electricity generating power plants in the U.S. is presented. The data are assembled by state and standard federal region. It shows plant location by county, company owner, unit name, nameplate rating, type of unit, primary and alternate fuels where known, status (existing or projected), date completed or estimated to be complete, source of information, and last update of information. The projected plant section provides additional information on status of environmental impact statements, prime component delivery, permit problems, construction start date, and scheduled completion date. GRA

N77-25660# Army Construction Engineering Research Lab., Champaign, Ill.
PREDICTING THE PERFORMANCE OF SOLAR ENERGY SYSTEMS Final Report
D. C. Hittle, G. N. Walton, D. F. Holshouser, and D. J. Leverenz Jan. 1977 46 p refs
(DA Proj. 4A7-63734-DT-08)
(AD-A035608; CERL-IR-E-98)' Avail: NTIS HC A03/MF A01 CSCL 10/1

This report presents a method for making an energy and life cycle cost analysis of solar energy systems. A graphical method is presented for predicting the performance of solar domestic hot water systems, solar heating systems, and solar heating and cooling systems. Methods for selecting the optimum collector area based on life cycle cost and for systematically making detailed design calculations using the building loads analysis and system thermodynamics blast computer simulation program are also presented. Practical considerations for solar system designs are discussed. The methods presented provide the required accuracy for both initial evaluations and final design calculations. Examples are provided throughout the test to aid in using the methods described. GRA

N77-25661# Logistics Management Inst., Washington, D. C.
PROJECT INDEPENDENCE EVALUATION SYSTEM (PIES) DOCUMENTATION. VOLUME 1: THE INTEGRATING MODEL OF THE PROJECT INDEPENDENCE EVALUATION SYSTEM
Sep. 1976 438 p
(Contract FEA-CR-03-60501-00)
(PB-263020/0; FEA/N-76/411-Vol-1) Avail: NTIS HC A19/MF A01 CSCL 10A

The Project Independence Evaluation System (PIES) is a complex computer model developed by the FEA for its use in energy policy analyses. PIES represents the energy economy of the nation on an average day in selected target years-1980, 1985, or 1990. By varying the assumptions and data, the model is used to simulate the effect of differing energy policies or trends. The entire model is described in a general fashion as well as the specific implementation of different sectors of the supply portion of the model. The supply portion of the model contains fossil fuel supply activities, fuel conversion activities and transportation activities. GRA

N77-25662# Maine Univ., Orono. Dept. of Electrical Engineering.
TERNARY COMPOUND THIN FILM SOLAR CELLS Final Report, 1 Jun. - 31 Aug. 1976
L. L. Kazmerski Oct. 1976 58 p refs
(Grant NSF AER-75-19576)
(PB-262536/6; NSF/RA-760351) Avail: NTIS HC A04/MF A01 CSCL 10B

The materials under investigation are CuInS2, CuInSe2 and CuInTe2--and, both homojunctions and heterojunctions involving these chalcopyrite materials are under consideration. The primary development during the final quarter was concerned with the CdS/CuInSe2 heterojunction. A 'best' efficiency of 6.2% was achieved for this device. An Auger electron spectroscopy depth-compositional analysis of this device has indicated that the diffusion of Cd from the CdS layer into the CuInSe2 film is a possible degradation problem for this solar cell. The grain boundary diffusion coefficient of Cd (from CdS) into CuInSe2 was determined using the Hall-Morabito formalism. The production of CuInS2 homojunction and CuInS2/CdS heterojunction solar cells is also reported. GRA

N77-25663# RCA Labs., Princeton, N. J.
EPITAXIAL SILICON TECHNOLOGY FOR LOW-COST SOLAR CELLS Final Report, 1 May 1975 - 30 Apr. 1976
H. Kressel, R. DAiello, E. R Levin, P. M. Raccah (Yeshiva Univ.), F. H. Pollack (Yeshiva Univ.), S. H. McFarlane, and P. Robinson
May 1976 97 p refs
(Grant NSF AER-74-15532)
(PB-262396/5; PRRL-76-CR-25; NSF/RANN/SE/AER74-15532/PR-76; NSF/RA-760355)
Avail: NTIS HC A05/MF A01 CSCL 10B

A method is demonstrated for improving solar cell devices by using thin epitaxial layers deposited on polycrystalline silicon ribbon. The program encompasses analytical studies aimed at relating the defects to device performance, and the fabrication of solar cells on a comparative basis (diffusion vs. epitaxial growth on crystals of similar quality) to establish the improvement which is obtained. The program demonstrates substantially improved performance with approximately 50 micrometer-thick epitaxial layers compared with those made by direct diffusion. The difference in performance is analyzed in detail, to yield significant new insight into the factors controlling the solar cell efficiency when such devices are fabricated in large-grained polycrystalline silicon ribbon. GRA

N77-25665# KVB Engineering, Inc., Tustin, Calif.
ASSESSMENT OF THE POTENTIAL FOR ENERGY CONSERVATION THROUGH IMPROVED INDUSTRIAL BOILER EFFICIENCY, VOLUME 1 Final Report
Jan. 1977 276 p refs
(Contract FEA-C-04-50085-00)
(PB-262576/2; FEA/D-77/025) Avail: NTIS HC A13/MF A01 CSCL 13A

Boiler efficiency in the use of gas, oil, and coal was studied. Cost effective equipment additions and improvements, including heat-recovery devices and combustion controls are discussed. Maximum attainable efficiencies using current technologies without consideration for cost are also reported. GRA

N77-25666# Little (Arthur D.), Inc., Cambridge, Mass.
A LOCATION MATRIX PLAN FOR THE RESIDENTIAL SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM. VOLUME 2: PROCEDURES AND APPENDICES
May 1976 292 p refs
(Contract HUD-H-2350)
(PB-262646/3; ADL-C-785384-Vol-2) Avail: NTIS HC A13/MF A01 CSCL 13A

A detailed plan is provided for the experimental portion of the residential solar heating and cooling demonstration program to be conducted by HUD. The plan is designed to permit HUD, in a structured series of demonstration projects, to investigate the effect of building codes, zoning regulations, tax procedures, and other administrative activities on the practical use of solar energy for heating and cooling buildings and heating domestic water in various climate and geographic areas. Volume II explains the methodology used in developing the recommendations, the procedures followed in the selection of site locations, and describes some of the constraints identified in the study. GRA

N77-25667# ICF, Inc., Washington, D.C.
ELECTRIC UTILITY COAL CONSUMPTION AND GENERATION TRENDS, 1976-1985
Nov. 1976 49 p refs
(Contract FEA-P-05-76-2660-0)
(PB-262483/1; FEA/G-76/428) Avail: NTIS HC A03/MF A01 CSCL 10B

In 1975, electric utilities accounted for roughly 400 million tons or 73% of total domestic coal consumption, a dramatic increase of 45% since 1955. For these and other reasons, well founded estimates of future coal consumption for electricity generation are becoming increasingly important to a number of interested parties including utility planners, coal producers, government policy makers and environmentalists. The annual reports of the nine Regional Electric Reliability Councils to the Federal Power Commission on the status of their respective Bulk Power Supply Programs provide much of the basic data necessary for constructing such a detailed utility coal consumption forecast. This study updates last year's effort based on the regional councils' April 1, 1976 submissions. Included are a reexamination of the future trends in generation requirements and capacities implicit in the councils' data and new forecasts of utility coal consumption under alternative electricity demand growth assumptions. GRA

N77-25668# Federal Energy Administration, Washington, D. C. Office of the Administrator.
FEDERAL ENERGY INFORMATION GATHERING ACTIVITIES: A REPORT TO THE PRESIDENT OF THE UNITED STATES, AND THE ENERGY RESOURCES COUNCIL
Dec. 1976 49 p
(PB-262844/4; FEA/T-77/033) Avail: NTIS HC A03/MF A01 CSCL 10A

Federal Energy Administration activities concerning energy information is reported. The present system of Federal energy data gathering activities is described, and recommendations with respect to the coordination of energy information activities within the Federal Government are provided. GRA

N77-25669# Bureau of Mines, Pittsburgh, Pa. Eastern Field Operation Center.
PROJECTS TO EXPAND FUEL SOURCES IN EASTERN STATES: SURVEY OF PLANNED OR PROPOSED COAL MINES, COAL AND NONCOAL CONVERSION PLANTS, ELECTRIC GENERATING PLANTS, OIL REFINERIES,

URANIUM ENRICHMENT FACILITIES, AND RELATED INFRASTRUCTURE, IN STATES EAST OF THE MISSISSIPPI RIVER (AS OF JUNE 1976)
Dec. 1976 121 p refs
(PB-262361/9; BM-IC-8725) Avail: NTIS HC A06/MF A01 CSCL 10A

Tables listing the name, location, and other pertinent data concerning future fuel related projects are presented. The tables include information on projects involving the proposed or planned development of fuel resources, as well as the development of storage, transportation, and conversion facilities. The 26 states east of the Mississippi River are included. Of the total 592 projects for which information is provided, 492 concern coal mines and electric generating plants. GRA

N77-25670# Booz-Allen and Hamilton, Inc., Washington, D. C.
THE EFFECTIVENESS OF SOLAR ENERGY INCENTIVES AT THE STATE AND LOCAL LEVEL
Mar. 1976 95 p refs
(Contract FEA-CO-05-50272-00)
(PB-263371/7; FEA/G-77/046) Avail: NTIS HC A05/MF A01 CSCL 13A

The Federal Energy Administration (FEA) is currently developing policies and programs to accelerate the utilization and widespread commercialization of solar energy technologies. Existing, proposed and possible state and local actions to encourage or stimulate the use of solar energy heating and cooling systems are reviewed. The state and local issues surrounding widespread solar energy development, and areas for assessment and evaluation, both in the design of state and local incentive programs and in the development of Federal support of those efforts, are emphasized. GRA

N77-25672# Coast Guard Research and Development Center, Groton, Conn.
LABORATORY EVALUATION OF SOLAR POWER UNITS FOR MARINE AIDS TO NAVIGATION Interim Report
J. S. Ryba and David A. Naus Jun. 1976 80 p ref
(AD-A034987; CGR/DC-5/76; USCG-D-106-76) Avail: NTIS HC A05/MF A01 CSCL 10/2

This report describes the Coast Guard evaluation of solar energy as a power source for lighted aids to navigation. Fifty-three solar powered aids, on test in a natural environment at Groton, Connecticut, have been continuously monitored for two years. Solar arrays from two manufacturers were tested with neither being wholly satisfactory. One had major quality control problems while the other suffered from inadequate sealing. Three types of lead-acid batteries used for energy storage have all been satisfactory to date. The test has indicated the advantages of voltage regulation in reducing water use in batteries, but has not proved that regulation is in fact required for long battery life. The insolation measured has shown excellent agreement with that predicted using the averages from a surrogate area. Almost all of the original estimates that were made to predict system performance (battery capacity vs. time of year) proved to be very conservative and most of the systems performed better than expected. Author (GRA)

N77-25673# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Atomic and Molecular Science.
REPORT OF THE SUBCOMMITTEE ON ENERGY-RELATED ATOMIC AND MOLECULAR SCIENCE Report, Feb. - Oct. 1975
Charles K. Reed Sep. 1976 85 p refs
(PB-264052/2; NSF/ERG-75-48) Avail: NTIS HC A05/MF A01 CSCL 10A

The use of fundamental atomic and molecular physics in directed energy-related areas of research, including: fusion research, fission research, fossil fuel research, laser development, and gaseous electronics are explored. GRA

N77-25674# Natural Resources Defense Council, Inc., Palo Alto, Calif.
CHOOSING AN ELECTRICAL ENERGY FUTURE FOR THE PACIFIC NORTHWEST: AN ALTERNATIVE SCENARIO Final Report
Roger Beers and Terry R. Lash 31 Jan. 1977 187 p refs
(PB-264048/0) Avail: NTIS HC A09/MF A01 CSCL 10A

The scenario is based primarily upon an analysis of each major end use of electricity in all sectors of the Pacific Northwest. On this basis, it forecasts the improvements in the efficiency of energy use, which are likely without any change in current policies or programs, together with the greater efficiencies which could be achieved by new initiatives. GRA

N77-25675# Army Electronics Labs., Fort Monmouth, N. J.
METHANOL-AIR BATTERIES
John Perry, Jr. Jan. 1977 32 p refs
(AD-A035942; ECOM-4457) Avail: NTIS HC A03/MF A01 CSCL 10/2

The methanol-air battery shows promise of meeting the operational requirements of low power equipment, such as sensors, mines, and similar equipments. While primarily designed to satisfy low level output requirements, the system is capable of supporting transient peak loads on a cyclical basis. Cells charged with 120 ml of anolyte, consisting of 6 M methanol in 11 M KOH, have operated for 2,230 hours under cyclic load drains of 50 MA for 13 minutes and 2 A for 1 second. One cell operated for more than 8,000 hours with periodic refilling of fresh anolyte, demonstrating the long serviceable life of the electrode components. Fuel utilization efficiencies as high as 84 % have been obtained from cells charged with an anolyte solution of methanol in potassium hydroxide. Single cells charged with a fuel mixture of methanol and methyl formate in 5 M KOH operated satisfactorily under load at temperatures down to -40 C, with only a 30% decrease in voltage during the 2 A period of the cycle. GRA

N77-25677# Battelle Columbus Labs., Ohio. Tactical Technology Center.
A SUMMARY OF THE DARPA ENERGY AND MATERIALS SHORTAGES PROGRAMS, FISCAL YEARS 1972-1976 Final Report
James O. Frankosky, Charles Ravitsky, and Frank Milner Dec. 1976 199 p refs
(Contract DAAH01-72-C-0982; ARPA Order 2209)
(AD-A036021; A-4825) Avail: NTIS HC A09/MF A01 CSCL 15/5

This report presents a summary of the several research efforts by DARPA during fiscal years 1972-1976 for investigations in the fields of energy and materials shortages. It is essentially a summary program completion report. It presents an overview, broken down into four major areas energy availability and national security considerations, alternate sources of energy at military installations, energy alternatives in propulsion, and potential materials shortages and their implications for national security. The overview is supported by the appendices, each addressing a separate area of investigation. Author (GRA)

N77-25684# Commerce Dept., Washington, D.C. Office of Environmental Affairs.
ENERGY REQUIREMENTS FOR AIR POLLUTION CONTROL IN THE PRIMARY ALUMINUM INDUSTRY Final Report, Sep. 1975 - Jan. 1977
Richard J. Herbst and Robert B. Grant Jan. 1977 96 p refs
(PB-264483/9) Avail: NTIS HC A05/MF A01 CSCL 13B

Environmental regulations and production processes in the primary aluminum industry which are most important in terms of the amounts of energy consumed for pollution control purposes are identified. The relationship between energy consumption and pollution control is quantified in a detailed and comprehensive manner which considers both direct (in-plant) and indirect (pre- and post-plant) effects. GRA

N77-25685# Battelle Pacific Northwest Labs., Richland, Wash.
MEASUREMENT OF DRY DEPOSITION OF FOSSIL FUEL PLANT POLLUTANTS Final Report, 24 Jun. 1974 - 24 Jun. 1976
J. G. Droppo, D. W. Glover, A. B. Abbey, C. W. Spicer, and J. Cooper Nov. 1976 135 p refs
(Contract EPA-68-02-1747)
(PB-264495/3; EPA-600/4-76-056) Avail: NTIS HC A07/MF A01 CSCL 13B

Dry removal of air pollutants from fossil fuel plants is considered from both a modeling and measurement viewpoint. Literature on dry deposition rates is summarized and the processes involved in dry deposition are discussed. The dry deposition of SO2, O3, NOx, and NO, as well as total sulfur and lead particles are considered. A prototype field data acquisition system was developed, assembled, and tested. Deposition velocities were computed for each field test. The sulfur dioxide profiles gave reasonable estimates of the dry deposition values, comparable to those in the literature. They varied from 0.10 to 2.38 cm/sec for the test runs. Values for the O3 deposition velocities were very small. The results for NO varied over a wide range, with the number of profiles measured in the test runs insufficient for reaching a definitive conclusion. GRA

N77-25965# Princeton Univ., N. J. Plasma Physics Lab.
CHEMICAL ENGINEERING SIDE OF NUCLEAR FUSION POWER
E. F. Johnson Oct. 1976 79 p refs
(Contract E(11-1)-3073)
(PPPL-1303) Avail: NTIS HC A05/MF A01

It is widely recognized that chemical engineering has important roles to play in the development of national and world wide energy resources through optimal utilization of fossil fuel reserves. It is much less appreciated that there are crucial chemical engineering problems in the development of energy production from other sources. In particular the successful development of nuclear fusion power generating systems will require the solution of many problems that are uniquely suited to chemical engineers. A brief overview of the fusion development program presents an identification of the major technological problems remaining to be solved. ERA

N77-26004# Coastal Environments, Inc., Baton Rouge, La.
A PROCESS FOR COASTAL RESOURCE MANAGEMENT AND IMPACT ASSESSMENT
Aug. 1976 130 p Sponsored in part by Louisiana State Planning Office
(PB-264811/1; NOAA-77021609) Avail: NTIS HC A07/MF A01 CSCL 13B

Although offshore development may introduce some specialized impacts, such as those resulting from pipelines, other impacts arise from general developments, such as housing, industry and drainage canals supporting offshore activities. A management and planning approach to assessing onshore impacts from offshore development is outlined. GRA

N77-26028# Voorhees (Alan M.) and Associates, Inc., McLean, Va.
STUDY OF FUTURE PARATRANSIT REQUIREMENTS Final Report
Jan. 1977 278 p refs
(PB-264082/9; UMTA-IT-06-0104-77-2) Avail: NTIS HC A13/MF A01 CSCL 13B

A range of paratransit service concepts in context with a set of typical urban settings under three alternative 1995 futures are examined. These alternative futures are described in terms of energy cost and degree of automobile disincentives. Integrated transit and paratransit systems are defined and match a combination of transit and paratransit services with forcasted transportation needs for each individual setting. Using estimated representativeness factors for each setting, the setting results are expanded to provide order-of-magnitude nation-wide estimates of potential future paratransit activity. These estimates are presented in terms of passenger demand, subsidy requirements, and vehicle requirements. GRA

N77-26107# Committee on Commerce (U. S. Senate).
OVERSIGHT HEARINGS ON THE SST
Washington GPO 1976 137 p refs Hearing before Comm. on Commerce, 94th Congr., 2d Sess., 20 Feb. 1976
(GPO-76-492) Avail: Comm. on Commerce

The decision to allow the Concorde supersonic transport aircraft to fly to the United States is reviewed. Factors considered include noise, ozone depletion, and fuel conservation. Protection of the environment is emphasized. J.M.S.

N77-26134*# Curtiss-Wright Corp., Wood-Ridge, N.J.
PERFORMANCE, EMISSIONS, AND PHYSICAL CHARACTERISTICS OF A ROTATING COMBUSTION AIRCRAFT ENGINE
M. Berkowitz, W. L. Hermes, R. E. Mount, and D. Myers Dec. 1976 116 p refs
(Contract NAS3-20030)
(NASA-CR-135119; CW-WR-76-028.2) Avail: NTIS HC A06/MF A01 CSCL 21A

The RC2-75, a liquid cooled two chamber rotary combustion engine (Wankel type), designed for aircraft use, was tested and representative baseline (212 KW, 285 BHP) performance and emissions characteristics established. The testing included running fuel/air mixture control curves and varied ignition timing to permit selection of desirable and practical settings for running wide open throttle curves, propeller load curves, variable manifold pressure curves covering cruise conditions, and EPA cycle operating points. Performance and emissions data were recorded for all of the points run. In addition to the test data, information required to characterize the engine and evaluate its performance in aircraft use is provided over a range from one half to twice its present power. The exhaust emissions results are compared to the 1980 EPA requirements. Standard day take-off brake specific fuel consumption is 356 g/KW-HR (.585 lb/BHP-HR) for the configuration tested. Author

N77-26222*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLAR ARRAY MAXIMUM POWER TRACKING WITH CLOSED-LOOP CONTROL OF A 30-CENTIMETER ION THRUSTER
R. P. Gruber Mar. 1977 25 p refs
(NASA-TM-X-73643; E-9148) Avail: NTIS HC A02/MF A01 CSCL 21C

A new solar array/ion thruster system control concept has been developed and demonstrated. An ion thruster beam load is used to automatically and continuously operate an unregulated solar array at its maximum power point independent of variations in solar array voltage and current. Preliminary tests were run which verified that this method of control can be implemented with a few, physically small, signal level components dissipating less than two watts. Author

N77-26247 Materials Research Labs., Maribyrnong (Australia).
XRF ANALYSIS OF SOME REGENERATED CATALYSTS
W. B. Searle Oct. 1976 30 p refs
(MRL-TN-388; AR-282) Copyright. Avail: Issuing Activity

A grinding-briquetting technique was developed for the preparation of samples of regenerated petroleum cracking catalysts to provide rapid, accurate analysis of contaminants. The trace elements vanadium, chromium, iron, nickel, copper, zinc, lead, the rare earths, lanthanum, cerium, neodymium, may all be determined on the one sample. A more informative empirical formula for evaluating the level of trace metal contamination in regenerated stock is proposed. Author

N77-26253# Sandia Labs., Livermore, Calif.
COMBUSTION RESEARCH AT SANDIA LABORATORIES
Oct. 1976 28 p refs Presented at ERDA Contractors' Coordination Meeting, Ann Arbor, Mich., 18 Oct. 1976
(Contract E(29-1)-789)
(SAND-76-8511) Avail: NTIS HC A03/MF A01
Combustion research with respect to internal combustion engines is illustrated graphically. ERA

N77-26324# Battelle Columbus Labs., Ohio.
SYSTEMS STUDY OF FUELS FROM SUGARCANE, SWEET SORGHUM, SUGAR BEETS, AND CORN Quarterly Report for period ending 15 Jun. 1976
E. S. Lipinsky, T. A. McClure, W. J. Sheppard, J. L. Otis, W. T. Lawhon, and R. A. Nathan 30 Jun. 1976 95 p refs
(Contract W-7405-eng-92)
(TID-27336; QR-4) Avail: NTIS HC A05/MF A01
Preliminary results are presented of an economic analysis of the agricultural and conversion aspects of producing fuel and ammonia from sugar beets, sweet sorghum, and corn. Ethanol would be produced by fermentation of cane juice and methanol and ammonia from the synthesis of gas obtained from the partial oxidation of the combustible organics using the Purox process. ERA

N77-26325# Arizona State Univ., Tempe. College of Engineering and Applied Sciences.
CONVERSION OF WASTE ORGANIC MATERIAL TO GASOLINE
James L. Kuester 1976 7 p refs Presented at the 4th national conference on Energy and the Environment, Cincinnati, Oct. 1976
(Contract E(11-1)-2982; N60530-76-C-0121; Grant NSF SMI-76-02988)
(COO-2982-7; Conf-761016-6) Avail: NTIS HC A02/MF A01
The method is based on the Fischer-Tropsch synthesis of straight-chain hydrocarbons from the pyrolysis gas with the subsequent reforming of these hydrocarbons to gasoline. The concept appears technically feasible. Implementation on a large scale is dependent on refinements in process performance and demonstrated operational reliability. If these objectives are achieved, the process economics could be attractive. ERA

N77-26330# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
ENGINE PERFORMANCE AND FIRE-SAFETY CHARACTERISTICS OF WATER-CONTAINING DIESEL FUELS Interim Report, Jun. - Aug. 1976
Edwin C. Owens and Bernard R. Wright Dec. 1976 27 p refs
(Contracts DAAK02-75-C-0082; DAAG53-76-C-0003)
(AD-A036011; AFLRL-83) Avail: NTIS HC A03/MF A01 CSCL 21/4
Recent flammability evaluations conducted at U.S. Army Fuels and Lubricants Research Laboratory AFLRL have shown that water-containing diesel fuels are more fire resistant 'even at temperatures above the flash point' than the same fuel without the water added. These findings led to this project to evaluate the compatibility of such fuels with a full scale diesel engine. Blends of base diesel fuel plus 2-percent emulsifying agent plus as much as 10-percent water were evaluated in an unmodified LDT-465-1 C, a multifuel diesel engine with wide field usage. No significant changes were observed in power output when operating the engine at equal base fuel flow rates. The smoke-reduction effects were inconclusive, but the nonvisible emissions were substantially altered. Oxides of nitrogen emissions were decreased as much as 30 percent but were accompanied by a 250-percent increase in unburned hydrocarbons. The conclusion followed that potential fire-safety benefits and a lack of major detrimental effects in the engine make these water/fuel blends attractive candidates for fire-resistant combat fuels.
Author (GRA)

N77-26393# Avco-Everett Research Lab., Everett, Mass.
CDIF COMBUSTOR DESIGN Final Report
D. B. Stickler and R. T. Barnes Jun. 1976 81 p refs
(Contract W-31-109-eng-38)
(TID-27143) Avail: NTIS HC A05/MF A01
Magnetohydrodynamic (MHD) electric power development offers a major opportunity for better utilization of U.S. coal supplies. Conceptual studies of MHD power systems project coal pile to bus bar plant efficiencies up to 50 percent better than modern steam cycles and 20 to 30 percent better than advanced combined gas turbine-steam turbine cycles. MHD offers further potential advantages in control of environmental emissions. The MHD Development Program established by ERDA for meeting the goal of commercial MHD demonstration by the late 1980's progresses through four overlapping phases, each focused firmly on the eventual commercial requirements. The initial phase will develop the technology required to design, develop and demonstrate subscale system components and subsystems. This report addresses one aspect of the initial phase of the ERDA MHD overall development plan and that is the development of a combustor conceptual design for testing in the CDIF. The CDIF combustor design is capable of ultimately being increased in size to a 2,000 MW thermal MHD commercial plant. ERA

N77-26439# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
A NUMERICAL MODEL TO EVALUATE THE BEHAVIOR OF A REGENERATIVE HEAT EXCHANGER AT HIGH TEMPERATURE
A. J. Geutjes Nov. 1976 46 p refs
(TH-76-E-66; ISBN-90-6144-0661) Avail: NTIS HC A03/MF A01
A mathematical model describing the heat transport in regenerative heat exchangers for an experimental MHD generator is presented. Solution of the set of equations by the method of successive overrelaxation results in the gas and material temperature along the height of the regenerator during the heating and cooling period is described. The temperature of the argon gas leaving the heater was also found. Calculations were made for heat exchangers filled with spheres and for heaters filled with cored bricks. In the first computations the inlet temperature and composition of the combustion gas were taken as constant. Axial heat conduction was assumed negligible. Radiative heat transfer from the combustion gas was included in the model. The results of the study are in qualitative agreement with experimental data. A quantitative comparison between this theory and experiments was hampered by lack of information regarding the burner settings during the heating period. Author (ESA)

N77-26491# TRW Defense and Space Systems Group, Redondo Beach, Calif.
INVESTIGATION OF BEAMED ENERGY CONCEPTS FOR PROPULSION. VOLUME 1: SYSTEMS STUDIES Final Report, 2 Sep. 1975 - 1 Jul. 1976
M. Huberman, J. M. Sellen, R. Benson, W. Davenport, and R. Davidheiser Oct. 1976 259 p refs 2 Vol.
(Contract F04611-76-C-0003)
(AD-A034995; AFRPL-TR-76-66-Vol-1) Avail: NTIS HC A12/MF A01 CSCL 20/5
The objective of this program is to assess the feasibility of the beamed energy propulsion concept for Air Force missions. The results of the study indicate that beamed energy propulsion is technically feasible. No fundamental obstacles have been identified. However considerable technical development is needed in many areas before the concept can be operationally implemented. In order to minimize the required collector area, laser concepts are preferred over microwaves. If space based laser transmitter concepts are to be cost effective they will require the availability of megawatt level space nuclear or solar power stations. In view of the large total energy required for each mission, ground based transmitters will be most cost effective when they are operated closed cycle from central station electric power. Laser transmitting ranges greater than several hundred nautical miles

will result in excessive collector sizes. Therefore, ground based transmitters applications will be restricted to orbital functions which can be performed at low orbital altitudes. Three promising applications have been identified. The laser powered tug can be cost effective compared to an advanced cryogenic tug. Apsidal rotation correction and drag make-up are two other missions where significant advantages may be realized for the laser powered concept. GRA

N77-26595# Brookhaven National Lab., Upton, N.Y. Dept. of Applied Science.
REGIONAL LAND USE AND ENERGY MODELING
A. S. Kydes, J. B. Sanborn, and T. O. Carroll 1976 12 p refs Presented at Intern. Conf. on Cybernetics and Soc., Washington, D. C., 1 Nov. 1976
(Contract E(30-1)-16)
(BNL-21809; Conf-761122-1) Avail: NTIS HC A02/MF A01

The land-use energy-simulation model with the integrated capability for generating energy demand is an extension of the classic Lowry model. Such a model framework described captures two essential features of the land use energy-utilization interaction: the spatial location of the land use activity is explicit, and transportation energy demand is determined as an integral part of the spatial configuration. The model is divided both conceptually and computationally into three parts: the land use model, a submodel for transportation which provides the work and shop trip distribution for spatial allocation of activities within the land use submodel, and an energy submodel which determines energy demand resulting from the land use configuration. ERA

N77-26606# Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
GEOCHEMISTRY AND HYDROTHERMAL ALTERATION AT SELECTED UTAH HOT SPRINGS, VOLUME 3 Final Report
W. T. Parry, Nancy Benson, and Charles D. Miller Jul. 1976 141 p refs
(Grant NSF GI-43741)
(PB-264415/1; NSF/RA-760370-Vol-3) Avail: NTIS HC A07/MF A01 CSCL 08I

Two hot spring areas in differing geological environments have been selected for detailed rock alteration studies. The Monroe-Red Hill area is within an area of Tertiary volcanics and is underlain by a thick Jurassic salt bearing deposit. The Roosevelt area is in Tertiary and Precambrian crystalline rocks. Comparison of rock alteration and water chemistry in these two areas should serve as a model for further exploration and resource characterization in Utah using geochemical techniques. GRA

N77-26610*# Wyle Labs., Inc., Huntsville, Ala.
ASSEMBLY AND TESTING OF A 1.8 BY 3.7 METER FRESNEL LENS SOLAR CONCENTRATOR Final Report
J. E. Robertson May 1977 72 p refs
(Contract NAS8-31662)
(NASA-CR-150300; TM-77-5) Avail: NTIS HC A04/MF A01 CSCL 10A

A project was initiated to establish a technical data base on line focusing acrylic Fresnel lenses for use in a solar collector system that could generate temperatures in the range of 200 C to 370 C. The effort was originally directed toward electric power generation in the 100 to 10,000 kWe range using a distributed collector approach. However, as the program progressed, it centered on the development of a concentrator/collector subsystem concept that could meet the general requirement of thermal delivery within the 200 C to 370 C range. The expanded list of possible applications includes commercial heating/cooling and industrial process heat as well as electric power generation. D.M.L.

N77-26611*# Alabama Univ., Huntsville. Johnson Environmental and Energy Center.
SOLAR HEATING AND COOLING TECHNICAL DATA AND SYSTEMS ANALYSIS Progress Report, Oct. 1974 - 30 Apr. 1977
D. L. Christensen May 1977 152 p
(Contract NAS8-31293)
(NASA-CR-150305) Avail: NTIS HC A08/MF A01 CSCL 10A

The research activities described herein were concentrated on the areas of economics, heating and cooling systems, architectural design, materials characteristics, climatic conditions, educational information packages, and evaluation of solar energy systems and components. Author

N77-26613*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VIBRATION CHARACTERISTICS OF A LARGE WIND TURBINE TOWER ON NON-RIGID FOUNDATIONS
Suey T. Yee, Tse-Young P. Cang, R. J. Scavuzzo, David H. Timmerman, and John W. Fenton May 1977 34 p refs
(Contract E(49-26)-1004)
(NASA-TM-X-73670; E-9194; ERDA/NASA-1004/77/1) Avail: NTIS HC A03/MF A01 CSCL 10A

Vibration characteristics of the Mod-0A wind turbine supported by nonrigid foundations were investigated for a range of soil rigidities. The study shows that the influence of foundation rotation on the fundamental frequency of the wind turbine is quite significant for cohesive soils or loose sand. The reduction in natural frequency can be greater than 20 percent. However, for a foundation resting on well graded, dense granular materials or bedrock, such effect is small and the foundation can be treated as a fixed base. Author

N77-26617*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF INITIAL COLLECTOR FIELD PERFORMANCE AT THE LANGLEY SOLAR BUILDING TEST FACILITY
Robert J. Boyle, Ronald N. Jensen (NASA Langley, Hampton, Va.), and Richard H. Knoll Jun. 1977 22 p refs Presented at the 10th Ann. Meeting of the Am. Sect. of the Intern. Solar Energy Soc., Orlando, Fla.
(NASA-TM-X-73677) Avail: NTIS HC A02/MF A01 CSCL 10A

The thermal performance of the solar collector field for the NASA Langley Solar Building Test Facility is given for October 1976 through January 1977. A 1,180 square meter solar collector field with seven collector designs helped to provide hot water for the building heating system and absorption air conditioner. The collectors were arranged in 12 rows with nominally 51 collectors per row. Heat transfer rates for each row were calculated and recorded along with sensor, insolation, and weather data every five minutes using a minicomputer. The agreement between the experimental and predicted collector efficiencies was generally within five percentage points. Author

N77-26623*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SENSITIVITY OF SOLAR-CELL PERFORMANCE TO ATMOSPHERIC VARIABLES. 1: SINGLE CELL
Thomas M. Klucher [1976] 15 p refs Presented at 2d Ann. Photovoltaic Measurements Workshop, Baton Rouge, La., 10-12 Nov. 1976
(Contract E(49-26)-1022)
(NASA-CP-2010; ERDA/NASA-1022/76/6; TR-2-7) Avail: NTIS HC A02/MF A01 CSCL 10A

The short circuit current of a typical silicon solar cell under direct solar radiation was measured for a range of turbidity, water vapor content, and air mass to determine the relation of the solar cell calibration value (current-to-intensity ratio) to those atmospheric variables. A previously developed regression equation was modified to describe the relation between calibration value, turbidity, water vapor content, and air mass. Based on the value of the constants obtained by a least squares fit of the data to the equation, it was found that turbidity lowers the value, while increase in water vapor increases the calibration value. Cell

calibration values exhibited a change of about 6% over the range of atmospheric conditions experienced. Author

N77-26624*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SENSITIVITY OF SOLAR-CELL PERFORMANCE TO ATMOSPHERIC VARIABLES. 2: DISSIMILAR CELLS AT SEVERAL LOCATIONS
Thomas M. Klucher and Russell E. Hart [1976] 16 p refs
Presented at the 2d Ann. Photovoltaic Measurements Workshop, Baton Rouge, La., 10-12 Nov. 1976
(Contract E(49-26)-1022)
(NASA-CP-2010; ERDA/NASA-1022/76/7; TR-2-8) Avail: NTIS HC A02/MF A01 CSCL 10A

Several solar cells having dissimilar spectral response curves and cell construction were measured at various locations in the United States to determine sensitivity of cell performance to atmospheric water vapor and turbidity. The locations selected represent a broad range of summer atmospheric conditions, from clear and dry to turbid and humid. Cell short circuit current under direct normal incidence sunlight, the intensity, water vapor and turbidity were measured. Regression equations were developed from the limited data base in order to provide a single method of prediction of cell current sensitivity to the atmospheric variables. Author

N77-26628*# Westinghouse Research Labs., Pittsburgh, Pa.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), PHASE 2. VOLUME 1: SUMMARY AND COMBINED GAS-STREAM TURBINE PLANT WITH AN INTEGRATED LOW-BTU GASIFIER Final Report
D. T. Beecher 1 Nov. 1976 497 p refs
(Contracts NAS3-19407; E(49-18)-1751; Grant NSF AG-551)
(NASA-CR-134942-Vol-1; Rept-76-9E9-ECAS-R2-Vol-1) Avail: NTIS HC A21/MF A01 CSCL 10B

A parametric analysis of energy conversion concepts using coal or coal derived fuels is presented. Conceptual plant designs were formulated for three advanced power conversion concepts; (1) a combined gas steam turbine cycle whose gas turbines are air cooled, and burn a low Btu gas from coupled pressurized fluidized bed gasifiers, (2) a combined gas steam turbine cycle whose gas turbine expanders contain ceramic elements and burn a semiclean coal derived liquid from the H coal process, and (3) an advanced steam plant whose steam is pressurized fluidized bed boilers. A detailed analysis of performance, plant layout, capital cost, cost of electricity, natural resource requirements, and emissions of the three advanced concepts is also included. B.B.

N77-26629*# Westinghouse Research Labs., Pittsburgh, Pa.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), PHASE 2. VOLUME 2: SUMMARY AND COMBINED GAS-STEAM TURBINE PLANT USING COAL DERIVED LIQUID FUEL Final Report
D. T. Beecher 15 Oct. 1976 334 p refs
(Contracts NAS3-19407; E(49-18)-1751; Grant NSF AG-551)
(NASA-CR-134942-Vol-2; Rept-76-9E9-ECAS-R2-Vol-2) Avail: NTIS HC A15/MF A01 CSCL 10B
For abstract, see N77-26628.

N77-26630*# Westinghouse Research Labs., Pittsburgh, Pa.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), PHASE 2. VOLUME 3: SUMMARY AND ADVANCED STEAM PLANT WITH PRESSURIZED FLUIDIZED BED BOILERS Final Report
D. T. Beecher 1 Nov. 1976 398 p refs
(Contracts NAS3-19407; E(49-18)-1751; Grant NSF AG-551)
(NASA-CR-134942-Vol-3; Rept-76-9E9-ECAS-R2-Vol-3) Avail: NTIS HC A17/MF A01 CSCL 10B
For abstract, see N77-26628.

N77-26631*# General Electric Co., Schenectady, N.Y.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), PHASE 2. VOLUME 1: EXECUTIVE SUMMARY Final Report
J. C. Corman and G. R. Fox Dec. 1976 54 p refs
(Contracts NAS3-19406; E(49-18)-1751; Grant NSF AG-551)
(NASA-CR-134949-Vol-1; SRD-76-064-1-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 10B

A data base for the comparison of advanced energy conversion systems for electric utility baseload applications using coal or coal-derived fuels was developed. Conceptual designs were developed for seven systems to permit estimates of power plant efficiency, capital cost, environmental intrusion characteristics, natural resource requirements, and cost of electricity at an assumed capacity factor of 65%. The systems studied were advanced steam with atmospheric fludized bed (AFB) and pressurized fluidized bed (PFB) heat input subsystems, a closed helium gas turbine (organic bottoming) with an AFB, a potassium topping cycle with a PFB, a combined cycle gas turbine--water cooled--burning a coal-derived liquid fuel, a combined cycle gas turbine--air cooled--integrated with LBtu gasification, and an open cycle MHD system. An emissions limit target was specified for the power plant conceptual designs. A steam power plant (3,500 psig/1000 F/1000 F) with a coal-burning radiant furnace and a wet lime stack gas scrubber (stack reheat to 250 F), analyzed in a study using the same groundrules as ECAS, were used as references for comparison. All of the systems exhibited an estimated efficiency better than the 32% reference case. Five of the systems showed a lower cost of electricity than the 39.8 mills/kWh reference case. Development plans and cost estimates were prepared for the energy conversion portion of the respective systems. An implementation assessment was performed to estimate the potential applicability of the advanced energy conversion systems in electric utility generation systems. Author

N77-26632*# General Electric Co., Schenectady, N.Y.
ENERGY CONSERVATION ALTERNATIVES STUDY (ECAS), PHASE 2: VOLUME 2: ADVANCED ENERGY CONVERSION SYSTEMS, - CONCEPTUAL DESIGNS. PART 1: ANALYTICAL APPROACH Final Report
J. C. Corman, A. S. Robertson, R. D. Stewart, T. A. V. Cassel, and G. G. Johnson Dec. 1976 97 p refs
(Contracts NAS3-19406; E(49-18)-1751; Grant NSF AG-551)
(NASA-CR-134949-Vol-2-Pt-1; SRD-76-064-2-Vol-2-Pt-1)
Avail: NTIS HC A05/MF A01 CSCL 10B
For abstract, see N77-26631.

N77-26633*# General Electric Co., Schenectady, N.Y.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), PHASE 2. VOLUME 2: ADVANCED ENERGY CONVERSION SYSTEMS - CONCEPTUAL DESIGNS. PART 2: CLOSED TURBINE CYCLES Final Report
D. H. Brown, B. D. Pomeroy, and R. P. Shah Dec. 1976 274 p refs
(Contracts NAS3-19406; E(49-18)-1751; Grant NSF AG-551)
(NASA-CR-134949-Vol-2-Pt-2; SRD-76-064-2-Vol-2-Pt-2)
Avail: NTIS HC A12/MF A01 CSCL 10B
For abstract, see N77-26631.

N77-26634*# General Electric Co., Schenectady, N.Y.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), PHASE 2. VOLUME 2: ADVANCED ENERGY CONVERSION SYSTEMS - CONCEPTUAL DESIGNS. PART 3: OPEN CYCLE GAS TURBINES AND OPEN CYCLE MHD Final Report
L. P. Harris and R. P. Shah Dec. 1976 277 p refs
(Contract NAS3-19406; E(49-18)-1751; Grant NSF AG-551)
(NASA-CR-134949-Vol-2-Pt-3; SRD-76-064-2-Vol-2-Pt-3)
Avail: NTIS HC A13/MF A01 CSCL 10B
For abstract, see N77-26631.

N77-26635*# General Electric Co., Schenectady, N.Y.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), PHASE 2. VOLUME 2: ADVANCED ENERGY CONVERSION SYSTEMS: CONCEPTUAL DESIGNS. PART 4: SUMMARY OF RESULTS Final Report
D. H. Brown, J. C. Corman, G. G. Johnson, W. J. MacFarland, B. D. Pomeroy, and D. A. Woodford Dec. 1976 92 p refs
(Contracts NAS3-19406; E(49-18)-1751; Grant NSF AG-551)
(NASA-CR-134949-Vol-2-Pt-4; SRD-76-064-2-Vol-2-Pt-4)
Avail: NTIS HC A05/MF A01 CSCL 10B
For abstract, see N77-26631.

N77-26636*# General Electric Co., Schenectady, N.Y.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), PHASE 2. VOLUME 3: RESEARCH AND DEVELOPMENT PLANS AND IMPLEMENTATION ASSESSMENT Final Report
R. R. Bass, D. H. Brown, J. C. Corman, L. P. Harris, B. D. Pomeroy, and R. P. Shah Dec. 1976 347 p refs
(Contracts NAS3-19406; E(49-18)-1751; Grant NSF AG-551)
(NASA-CR-134949-Vol-3; SRD-76-064-3) Avail: NTIS HC A15/MF A01 CSCL 10B
For abstract, see N77-26631.

N77-26637*# United Technologies Corp., South Windsor, Conn.
ENERGY CONVERSION ALTERNATIVES STUDY (ECAS), PHASE 2. INTEGRATED COAL GASIFIER/MOLTEN CARBONATE FUEL CELL POWERPLANT CONCEPTUAL DESIGN AND IMPLEMENTATION ASSESSMENT Final Report
J. M. King 19 Oct. 1976 171 p refs Prepared in cooperation with Burns and Roe, Inc. and the Inst. of Gas Technol.
(Contract NAS3-19586)
(NASA-CR-134955; FCR-0237) Avail: NTIS HC A08/MF A01 CSCL 10A
For abstract, see N77-26631.

N77-26638# Rensselaer Polytechnic Inst., Troy, N. Y. Center for Technology Assessment.
AN ANALYSIS OF THE FEASIBILITY OF WINDMILLS FOR *POWER GENERATION IN NEW YORK STATE*
Robert Duffy Oct. 1976 136 p refs
(RPI-TA-17) Avail: NTIS HC A07/MF A01
The potential use of wind energy as a source of generating electric power as a methodology is described for evaluating the economic viability and acceptability of windmills for wind energy conversion in a large size such as New York State. The minimum cost of energy production for a system yielding high levels of energy is determined. Elements in the evaluation include: (1) an analysis of recorded wind data from which available wind energy levels may be determined; (2) an engineering analysis of known windmill concepts to determine those specific windmills which have the greatest potential for large scale generation of synchronous ac current; and (3) a coupling of the selected mills and the available wind energy profiles with capital investment and operating cost information to determine isoeconomic contour lines throughout the state. Author

N77-26640# Energy Research Corp., Danbury, Conn.
NEW MATERIALS FOR FLUOROSULFONIC ACID ELECTROLYTE FUEL CELLS Interim Report, Dec. 1975 - Oct. 1976
Sandors G. Abens, Bernard S. Baker, Michael George, and Stanley Januszkiewicz Feb. 1977 31 p refs
(Contract DAAK02-75-C-0045)
(AD-A036988; ERC-0123-3; IR-3) Avail: NTIS HC A03/MF A01 CSCL 10/2
Hydrogen-air fuel cells were evaluated with both TFMSA (Trifluoromethane sulfonic acid) monohydrate and dilute TFMSA. Tolerance against flooding was increased by use of thick supported catalyst electrodes with the monohydrate. Fuel cells with 63% TFMSA were operated at room temperature for over 1,000 hours with no significant decay. The evaluation of supported platinum and tungsten carbide anode catalysts with dilute TFMSA was initiated. Silicon carbide was investigated as a matrix material with TFMSA. Author (GRA)

N77-26641# Energy Research Corp., Danbury, Conn.
FUEL CELL STACKS Interim Technical Report, Mar. - Aug. 1976
S. G. Abens and Bernard S. Baker Feb. 1977 31 p
(Contract DAAK02-74-C-0367)
(AD-A037586; ERC-7396-4; ITR-4) Avail: NTIS HC A03/MF A01 CSCL 10/2
Production and testing of phosphoric acid fuel cell stacks is described. Electrodes, matrices, and bipolar gas distribution plates with an active area of 0.4 sq. ft. have been tested. Initial performance of 10- and 35- cell stacks has been obtained. Some stacks have been operated for over 2,000 hours at 300F, and tolerance to CO has been demonstrated. Life testing of stacks has been impeded by lack of complete gastightness and deterioration of gas diffusion plates. Author (GRA)

N77-26642# Utah Univ., Salt Lake City. Dept. of Mechanical Engineering.
UNIVERSITY OF UTAH DIRECT CONTACT GEOTHERMAL POWER PROJECT REPORT. A COMPUTER PROGRAM FOR DETERMINING THE THERMODYNAMIC PROPERTIES OF WATER
David H. Riemer, Harold R. Jacobs, and Robert F. Boehm 1976 73 p refs
(Contract AT(10-1)-1523; Grant ERDA-AER-75-01039)
(UTEC-ME-76-171) Avail: NTIS HC A04/MF A01
A program was written to be used as a subroutine. The program determines the thermodynamic properties of water given any of the following pairs of knowns to define a thermodynamic state: pressure and entropy, pressure and enthalpy, pressure and quality, temperature and pressure, or temperature and quality. These five pairs of knowns allow the user to evaluate any thermodynamic cycle using water as a working fluid. The report includes a complete derivation of equations, program listing, program symbol description, a complete set of flow charts and a sample steam turbine calculation. ERA

N77-26644# AiResearch Mfg. Co., Phoenix, Ariz.
BRAXTON ISOTOPE POWER SYSTEM. PHASE 1: (GROUND DEMONSTRATION SYSTEM) CONFIGURATION CONTROL DOCUMENT (CCD)
15 Mar. 1976 238 p refs
(Contract EY-76-C-03-1123)
(TID-27252; AiResearch-75-3112748) Avail: NTIS HC A11/MF A01
The configuration control document (CCD) defines the BIPS-GDS configuration. The GDS (Ground Documentation Syst.) configuration is similar to a conceptual flight system design, referred to as the (Brayton Isotope Power System-Flight System) which is discussed. The BIPS is being developed as a 500 to 2,000 W(e),7-y life, space power system utilizing a closed Brayton cycle gas turbine engine to convert thermal energy (from an isotope heat source) to electrical energy at a net efficiency exceeding 25 percent. ERA

N77-26647# Sandia Labs., Albuquerque, N. Mex.
SILICON SOLAR CELL DEVELOPMENT FOR CONCENTRATED-SUNLIGHT, HIGH-TEMPERATURE APPLICATIONS
J. F. Fossum and E. L. Burgess 1976 7 p refs
(Contract E(29-1)-789)
(SAND-76-5311; Conf-761130-1) Avail: NTIS HC A02/MF A01
The development of silicon cells for use in concentrated-sunlight, high-temperature environments, based on theory and experiment, is presented. The theoretical work is aided by exact numerical simulations of the cells. Suggested cell designs are then fabricated using standard integrated circuit processing techniques. The designs are verified through computer-controlled testing of the cells at solar illuminations up to 90 suns and temperatures up to 100 C. The development of a 5-cm-diameter

silicon wafer cell for a 50-sun, approximately 100 C application is emphasized. ERA

N77-26649# Los Alamos Scientific Lab., N. Mex.
SUPERCONDUCTING ENERGY STORAGE DEVELOPMENT FOR ELECTRIC UTILITY SYSTEMS
R. D. Turner, H. J. Boenig, and W. V. Hasenzahl 1976 16 p refs Presented at 3d Ann. Conf. on Energy, Rolla, Mo., 13 Oct. 1976
(Contract W-7405-eng-36)
(LA-UR-76-2294; Conf-761038-1) Avail: NTIS HC A02/MF A01

Model SMES experiments were performed to show that magnetic energy storage in a superconducting magnet is a viable alternate to energy storage methods which are being built today. Component tests on a model SMES system include 12 pulse converters, automatic and manual converter power control system, and high current superconductors were performed to evaluate and develop systems which can be used on the 100 MJ SMES system that was designed. Test circuits were designed and used for economical and nondestructive testing of magnets for superconductor performance and evaluation. A closed-loop model SMES system was developed and built to study the electrical characteristics of the system. Initial test results were obtained for a symmetrically and asymmetrically triggered twelve-pulse converter. The asymmetrically triggered bridge shows the lower reactive power requirement, but a more distorted line current. Tests with the automatic control system show that a SMES system has switching times between the charging and discharging mode of about a cycle and a half. ERA

N77-26650# Brookhaven National Lab., Upton, N.Y. Policy Analysis Div.
ENERGY SITUATION IN NEW ENGLAND
Joel P. Brainard, James S. Munson, and Philip F. Palmedo Nov. 1976 57 p refs
(Contract EY-76-C-02-0016)
(BNL-50580) Avail: NTIS HC A04/MF A01

A concise overview is given of the facts of the energy situation in New England and of attitudes within the region towards current energy issues. Many of the central problems of U.S. energy policy are manifested in the region in a magnified form. The region entered the period of energy shortages and increasing prices in an economically declining condition. Manufacturing activity and jobs were being lost to other regions of the country, and personal income was increasing at significantly slower rates. With essentially no indigenous energy resources, New England is an energy-importing region; over 60 percent of the fuels it consumes is imported from abroad. Although the future supply of energy to the region is critically dependent on energy resource policies, policies related for example to coal and oil shale development, the region's concerns cluster around policies and technologies that are perceived to have a more direct impact on its energy welfare. Energy conservation, solar energy, nuclear power, offshore oil development and, in general, the price of energy to the region are discussed. ERA

N77-26651# California Univ., Livermore. Lawrence Livermore Lab.
WILL A RAPIDLY EXPANDING POWER-GENERATING SYSTEM BE PART OF THE ENERGY PROBLEM OR PART OF ITS SOLUTION
G. D. Sauter 12 Aug. 1976 24 p refs Presented at Frontiers of Power Technol. Conf., Stillwater, Okla., 27-28 Oct. 1976
(Contract W-7405-eng-48)
(UCRL-78500; Conf-761030-1) Avail: NTIS HC A02/MF A01

A methodology for the dynamic net energy analysis of an expanding system of identical power-generating plants is described. Based on this methodology, which is applicable to all types of power plants, a numerical model for simulating the energy dynamics of an expanding power-generating system is developed. The results of applying the model to several illustrative examples are presented and discussed. ERA

N77-26652# California Univ., Livermore. Lawrence Livermore Lab.
TEMPERATURE DEPENDENCE OF THE PHOTOVOLTAIC PERFORMANCE OF SI CELLS UNDER BLUE, WHITE, AND NEAR-BANDGAP IRRADIATION
E. Fischer-Colbrie, R. Wichner, and E. J. Charlson 3 Dec. 1976 7 p refs Presented at 12th IEEE Photovoltaic Specialist Conf., Baton Rouge, Louisiana, 15 Nov. 1976
(Contract W-7405-eng-48)
(UCRL-76203; Conf-761130-3) Avail: NTIS HC A02/MF A01

The temperature depenence of V/sub oc/ and I/sub sc/ was investigated for various designs of solar cells under blue, white, and near-infrared illumination bands of equal photodensity thus producing carriers at different depths in the various cells. It was found that V/sub oc/vs. temperature relation showed practically no dependence on the depth at which excitation occurred. Delta V/sub oc/ was about twice as large for non-homojunction cells than for homojunctions. The change in short circuit current with temperature, however, is sensitive to the depth at which carrier generation occurs. A decrease of I/sub sc/, with increasing temperature has been shown for excitation near the surface, a strong increase for excitation deep in the bulk with values for the white light showing an average of both. ERA

N77-26653# Sandia Labs., Albuquerque, N. Mex.
EFFECTS OF SPECTRAL VARIATIONS ON SILICON CELL OUTPUT
E. C. Boes and I. J. Hall 1976 14 p Presented at Terrestrial PV Measurements Workshop, Baton Rouge, Louisiana, 10 Nov. 1976
(Contract E(29-1)-789)
(SAND-76-9142; Conf-761129) Avail: NTIS HC A02/MF A01

The performance of silicon solar cell at a specific location is usually predicted by multiplying the solar radiation incident at the site by the solar cell's efficiency. This efficiency is specified as the ratio of the cell's output to the radiant energy input to the cell under specified conditions. It would be better to use a procedure which takes into account the fact that the performance of silicon solar cells depends upon the spectral distribution of the incoming energy. This is generally not possible because there are very few records of the spectral distribution of terrestrial solar radiation. One existing data source consists of spectral measurements of daily, total-horizontal radiation. These data have been analyzed to determine the magnitude and character of the effects in silicon cell output resulting from real variations in the terrestrial solar spectrum. ERA

N77-26654# Atomics International, Canoga Park, Calif.
HYDRATION-DEHYDRATION CYCLING OF MgO-Mg(OH)2 FOR APPLICATION TO SOLAR HEAT STORAGE SYSTEMS
G. Ervin 30 Sep. 1976 19 p
(Contract E(04-3)-0701)
(AI-ERDA-13178) Avail: NTIS HC A02/MF A01

The system design requires a knowledge of rates of the dehydration and hydration reactions, and, in order that these rates be significant for practical applications, it must be shown that these rates are maintained as the material is cycled repeatedly through the anhydrous and hydrated condition. For solar heat storage operating on a daily cycle, for example, a 3-yr life requires somewhat more than 1,000 cycles. Besides the effect of cycling on reaction kinetics, the extent of corrosion by the inorganic oxide/hydroxide on its containment vessel during cycling is an important parameter. Also, since one form of the active material that appears to have some advantages is that of granules held together by an inorganic cement, it is important in this case to know if the granules are broken down by cycling. ERA

N77-26655# Atomics International, Canoga Park, Calif.
EXPERIMENTAL TEST OF GAS HEAT TRANSFER SYSTEM FOR HYDROXIDE HEAT STORAGE

G. Ervin 29 Oct. 1976 23 p
(Contract E(04-3)-0701)
(AI-ERDA-13176) Avail: NTIS HC A02/MF A01

The results of a series of tests using circulating gas as a means of heat transfer are given. On the basis of these results, it is concluded that circulating gas is a technically feasible concept, using steam as heat transfer fluid and using the chemical in the form of a fixed bed of porous granules. ERA

N77-26657# California Univ., Berkeley. Lawrence Berkeley Lab.
RESULTS FROM CIRCUMSOLAR RADIATION MEASUREMENTS
Donald F. Grether, Arlon Hunt, and Michael Wahlig Aug. 1976 8 p refs Presented at Joint Conf. of Am. Section of Intern. Solar Energy Soc. and Solar Energy Soc. of Can., Inc., Winnipeg, Canada, 15 Aug. 1976
(Contract W-7405-eng-48)
(LBL-5292; Conf-760842-18) Avail: NTIS HC A02/MF A01

Circumsolar radiation results from small-angle scattering of direct sunlight from atmospheric aerosols with dimensions on the order of, or greater than the wavelength of light. An instrument was developed to provide measurements of circumsolar radiation as a function of angular distance from the sun and wavelength, for various atmospheric conditions, geographic locations, and times of year. These measurements are used to predict accurately the performance of solar thermal conversion systems using focusing collectors, and to determine whether pyrheliometer data are adequate for estimating this performance. Sample data are presented for two geographic locations. ERA

N77-26659# Oak Ridge National Lab., Tenn.
APPLICATION OF THE ICE-MAKER HEAT PUMP TO AN ANNUAL CYCLE ENERGY SYSTEM
H. C. Fischer and E. A. Nephew Dec. 1976 36 p refs Presented at the ASME Winter Meeting, New York, Dec. 1976
(Contract W-7405-eng-26)
(CONF-761107-13) Avail: NTIS HC A03/MF A01

Design parameters and typical operating characteristics of the ice-maker heat pump are presented and discussed. An economic analysis indicates that the ice-maker heat pump is capable of supplying space heating to buildings at an operating cost of about $4.65/million Btu ($4.41/GJ) of heat delivered at the register. The corresponding operating costs for heat delivery by systems with an air-to-air heat pump, an oil-fired furnace, a gas-fired furnace, and electric resistance heating are: $5.86, $6.30, $6.26, and $11.72 per million Btu, respectively. The cost of supplying domestic hot water by means of an ice-maker heat pump is estimated and the storage of ice for later use as a cooling medium is investigated. Ice storage as a means of saving both money and fuel is analyzed on the basis of daily, weekly, and annual cycles. Particular attention is being given to the design and construction of cost-effective storage bins. ERA

N77-26660# Dubin-Mindell-Bloome Associates, New York.
NEW ENERGY CONSERVATION IDEAS FOR EXISTING AND NEW BUILDINGS
F. S. Dubin 1975 28 p Presented at the 1st ERDA-Wide Energy Conservation Symp., Albuquerque, N. M., 16-18 Sep. 1975
(CONF-750942-2) Avail: NTIS HC A03/MF A01

New equipment and system concepts are outlined, such as utilization of solar energy, heat pumps, heat pipes, desiccant dehumidification, and chilled and hot water storage systems; but it is shown that most of the new ideas are, in fact, innovative use of older technologies which must be reintroduced now. The importance of becoming thoroughly familiar with, and using, innovative systems which are available is stressed, rather than waiting for the development of new products. Examples are presented showing the energy conservation and economic benefits of industrial processes when integrated with building environmental control systems. Some suggestions are included for new product development. Some specific needs are high temperature solar collectors, low temperature absorption refrigeration equipment, and glass which changes its characteristics with varying ambient conditions. ERA

N77-26663# Battelle Columbus Labs., Ohio.
EVALUATION OF THE POTENTIAL ENVIRONMENTAL EFFECTS OF WIND ENERGY SYSTEM DEVELOPMENT Interim Final Report
Sharron E. Rogers, Michael A. Duffy, Julia G. Jefferis, Philip R. Sticksel, and Duane A. Tolle Aug. 1976 193 p refs
(Contract W-7405-eng-92; Grant NSF AER-75-07378)
(ERDA/NSF-07378-75/1; NSF/RA-706188) Avail: NTIS HC A09/MF A01

The first phase of an evaluation of the potential for environmental effects from the development of wind energy was completed. A keyworded bibliography concerning microclimatic alterations by wind and reactions of flora and fauna to altered wind regimes is presented. This literature serves as background material for discussion of potential microclimatic and ecological effects. ERA

N77-26664# Alaska Univ., College. Geophysical Inst.
STUDY OF ALASKAN WIND POWER AND ITS POSSIBLE APPLICATIONS Final Report, 1 May 1974 - 30 Jan. 1976
Tunis Wentink, Jr. 29 Feb. 1976 183 p refs
(Contract E(45-1)-2229; Grant NSF AER-74-00239A01)
(NSF/RANN/SE/AER74-00239/FR-26) Avail: NTIS HC A09/MF A01

The wind power potential of Alaska, is studied in both the meteorological and applies senses. The wind potential of the world is also treated. Specific goals are the determination of alternative applications and users of wind systems, optimum sites for these, and environmental problems associated with windmills used in Alaska. The program consists of seven tasks. ERA

N77-26665# Battelle Pacific Northwest Labs., Richland, Wash.
OTEC ANNUAL REPORT TO THE DIVISION OF SOLAR ENERGY FOR FY-1976 AND THE TRANSITION QUARTER
Lyle D. Perrigo and G. A. Jensen Nov. 1976 45 p refs
(Contract EY-76-C-06-1830)
(BNWL-2154) Avail: NTIS HC A03/MF A01

The methodology used to guide the technical efforts of the project activity office during its period of startup and before a detailed master plan is developed. The projects developed for funding in FY-1976 and the rationale for their selection are described. A summary of significant technical information, obtained from various projects is presented. ERA

N77-26668# Virginia Univ., Charlottesville.
ANALYSIS OF THERMAL PERFORMANCE OF SOLARIS WATER-TRICKLE SOLAR COLLECTOR
J. T. Beard, F. L. Huckstep, W. B. May, Jr., F. A. Iachetta, and L. U. Lilleleht 1976 27 p refs Presented at the Ann. Meeting of the ASME, New York, 29 Nov. 1976
(Contract AT-(40-1)-4927)
(CONF-761107-17) Avail: NTIS HC A03/MF A01

Thermal performance testing and evaluation of the Thomason Solaris water-trickle solar collector were undertaken with the aid of a special outdoor research facility. Results demonstrate the performance of the Thomason 'Solaris' collector with efficiencies ranging from 30 percent up to approximately 75 percent. These results show a nearly linear relationship as a function of the difference between inlet water temperature and the ambient temperature divided by the incident solar energy. The significant scatter in the data results from other variables which are analyzed in the paper. These variables include glazing cleanliness, angle of incidence, water evaporation and condensation, wind condition, and the influence of condensate droplets on the overall solar energy transmitted to the absorbing surface. The performance of the 'Solaris' water-trickle collector is compared with published results for conventional single and double flat-plate collectors. ERA

N77-26669# Virginia Univ., Charlottesville.
EVALUATION OF SOLARIS WATER-TRICKLE SOLAR COLLECTOR AND DEMONSTRATION OF ANNUAL CYCLE COLLECTION AND STORAGE OF SOLAR HEATED WATER

J. T. Beard, F. A. Iachetta, L. U. Lilleleht, J. W. Dickey, F. L. Huckstep, and W. B. May, Jr. 1976 18 p refs Presented at Conf. on Solar 3 Capturing the Sun, Evanston, Ill., 20 Nov. 1976
(Contract E(40-1)-4927)
(CONF-761143-1) Avail: NTIS HC A02/MF A01

Research on the thermal performance of the Thomason Solaris water-trickle solar collector is described. This work includes testing with the aid of a special outdoor collector research facility. Results demonstrate the collection efficiency ranges from 30% up to approximately 75%. Significant variables which influence efficiency include inlet water temperature, ambient temperature, incident solar energy, glazing cleanliness, angle of incidence, wind condition, and the evaporation and condensation which occur within the collector. The thermal performance of the Solaris water-trickle collector is compared with published results for conventional single and double flat-plate collectors. The second project involves the demonstration and evaluation of a system for the year-round collection of solar energy with storage for heating applications. The system resembles a swimming pool with an insulated top which acts as a solar collector as well as a device to limit the evaporative cooling of the water. ERA

N77-26670# Pennsylvania Univ., Philadelphia.
RESEARCH AND DEVELOPMENT OF LOW COST PROCESSES FOR INTEGRATED SOLAR ARRAYS
C. D. Graham, S. Kulkarni, and E. Louis May 1976 247 p refs Prepared jointly with Dow Corning Corp.
(Contract E(11-1)-2721)
(COO-2721-76-1) Avail: NTIS HC A11/MF A01

Potential processes for the production of solar-grade silicon are evaluated from thermodynamic, economic, and technical feasibility points of view. Upgrading of the present arc-furnace process is found most favorable. Experimental studies of the Si/SiF4 transport and purification process show considerable impurity removal and reasonable transport rates. Silicon deformation experiments indicate production of silicon sheet by rolling at 1350 C is feasible. Significant recrystallization by strain-anneal technique has been observed. Experimental recrystallization studies using an electron beam line source are discussed. A maximum recrystallization velocity of approximately 9 m/hr is calculated for silicon sheet. A comparative process rating technique based on detailed cost analysis is presented. ERA

N77-26673# Giner, Inc., Waltham, Mass.
STUDY OF CORROSION AND ITS CONTROL IN ALUMINUM SOLAR COLLECTORS Progress Report, 1 Jun. - 31 Aug. 1976
J. Giner, L. Sweete, and D. Wong Sep. 1976 26 p
(Contract E(11-1)-2934)
(COO-2934-76-1) Avail: NTIS HC A03/MF A01

Plans and methodology are described for investigating the corrosion of aluminum solar thermal energy collector systems, with the objective of deriving corrosion control methods. The corrosion characteristics of aluminum and selected aluminum alloys in heat transfer fluids, including ethylene glycol water, will be studied experimentally under conditions relevant to the operation of the existing solar collector installations. ERA

N77-26674# General Electric Co., Philadelphia, Pa. Space Div.
GENERAL ELECTRIC COMPANY SURVEY TO DEFINE IMPACT OF STATEWIDE BUILDING CODES ON SOLAR HVAC SYSTEMS, COMMERCIAL BUILDINGS. NATIONAL SOLAR DEMONSTRATION PROGRAM
Jul. 1976 164 p
(Contract E(11-1)-2683)
(COO-2683-76-11) Avail: NTIS HC A08/MF A01

The potential impact of statewide building codes and solar energy laws on the solar heating and cooling of buildings was investigated. The survey is limited to building and construction related codes and solar energy laws presently issued and enforced. Pending codes or ordinances are also reported. The review of the fire and safety codes was limited to their direct application with construction requirements. Author (ERA)

N77-26675# Cornell Univ., Ithaca, N.Y.
BIOCONVERSION OF AGRICULTURAL WASTES FOR POLLUTION CONTROL AND ENERGY CONSERVATION Final Report
W. J. Jewell, H. R. Davis, W. W. Gunkel, D. J. Lathwell, J. H. Martin, Jr., T. R. McCarty, G. R. Morris, D. R. Price, and D. W. Williams Sep. 1976 341 p refs
(Grant ERDA-NSF 741222-A01)
(TID-27164) Avail: NTIS HC A15/MF A01

A comprehensive study of the feasibility of generating a substitute natural gas on U.S. dairies (40 and 100 cows) and beef feedlots (1,000 head) using the anaerobic fermentation process is made. The feasibility in technical, economic and practical terms is estimated. A dairy farm in northern New York could produce more energy than it consumes, and a feedlot could produce more than 3 times the quantity consumed. The estimated costs of generating methane on 40 and 100 cow dairies and on a 1,000 head beef feedlot were $22.80, $13.40, and $4.50 per 10 to the 6th power kcal. Detailed analyses of the three operations estimated that the actual costs for utilization would increase to $80, $39, and $11 per 10 to the 6th power kcal for specific operations, respectively. Farms with more than 100 cows can begin to consider the technology as an income producing operation. It is therefore concluded that anaerobic fermentation of agricultural wastes has significant potential and should receive increased attention. ERA

N77-26676# Colorado State Univ., Fort Collins. Solar Energy Applications Lab.
COMPARATIVE PERFORMANCE OF SOLAR HEATING WITH AIR LIQUID SYSTEMS Interim Progress Report, 1 Feb. - 30 Aug. 1976
S. Karaki, G. O. G. Lof, and C. C. Smith Aug. 1976 20 p refs Presented at the Intern. Solar Energy Soc. Conf., Winnipeg, Canada, 16-20 Aug. 1976
(Contract E(11-1)-2868)
(COO-2868-1) Avail: NTIS HC A02/MF A01

A performance comparison between an air solar system and a liquid solar system for space heating under nearly equal conditions was obtained. The Colorado State University Solar House I is a liquid solar system which has been in operation since August 1974. Solar House II, which stands adjacent to and has a comparable heating load to Solar House I, is equipped with an air solar system. Solar House I has been continuously monitored since August 1974 and Solar House II has been monitored since February 1976. Performance of the solar systems is reported in terms of the collector efficiency, the amount of space heating and service water heating load provided by solar energy, and the use of electrical energy to operate the solar equipment. General characteristics of the two types of systems are also compared. Information concerning installation, operation, and maintenance of the systems are documented and are discussed. ERA

N77-26677# Mathematical Sciences Northwest, Inc., Bellevue, Wash.
A SOCIAL AND ECONOMIC IMPACT STUDY OF OFFSHORE PETROLEUM AND NATURAL GAS DEVELOPMENT IN ALASKA, PHASE 1 Final Report
15 Oct. 1976 427 p refs Prepared in cooperation with Human Resources Planning Inst., Seattle.
(Contract DI-08550-CT6-46)
(PB-264705/5; MSNW/HRPI-76-274; BLM/SE-77-02) Avail: NTIS HC A19/MF A01 CSCL 10A

The modeling of Alaska's economic experience with hydrocarbon development in the Kenai-Cook Inlet region is presented. The linkages between the petroleum sector and the rest of the Alaskan economy are examined. GRA

N77-26679# Little (Arthur D.), Inc., Cambridge, Mass.
ENVIRONMENTAL CONSIDERATIONS OF SELECTED ENERGY CONSERVING MANUFACTURING PROCESS OPTIONS. VOLUME 2: INDUSTRY PRIORITY REPORT Final Report
Dec. 1976 139 p refs
(Contract EPA-68-03-2198)
(PB-264268/4; EPA-600/7-76-034b-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 10A

The likelihood of new process technology and new practices being introduced by energy intensive industries is assessed, and the environmental impacts of such changes are explored. Volume 2 presents and describes the over-view of the industries considered and presents the methodology used to select industries. GRA

N77-26680# Little (Arthur D.), Inc., Cambridge, Mass.
ENVIRONMENTAL CONSIDERATIONS OF SELECTED ENERGY CONSERVING MANUFACTURING PROCESS OPTIONS. VOLUME 3: IRON AND STEEL INDUSTRY REPORT Final Report
Dec. 1976 107 p refs
(Contract EPA-68-03-2198)
(PB-264269/2; EPA-600/7-76-034c-Vol-3) Avail: NTIS HC A06/MF A01 CSCL 10A

The likelihood of new process technology and new practices being introduced by energy intensive industries is assessed, and the environmental impacts of such changes are explored. Volume 3 deals with the iron and steel industry and examines four alternatives: (1) recovery of carbon monoxide from BOP (basic oxygen process), (2) external desulfurization of blast-furnace hot metal, (3) conversion from wet to dry coke quenching and (4) direct reduction of iron ore, all in terms of relative process economics and environmental/energy consequences. GRA

N77-26681# Little (Arthur D.), Inc., Cambridge, Mass.
ENVIRONMENTAL CONSIDERATIONS OF SELECTED ENERGY CONSERVING MANUFACTURING PROCESS OPTIONS. VOLUME 4: PETROLEUM REFINING INDUSTRY REPORT Final Report
Dec. 1976 193 p
(Contract EPA-68-03-2198)
(PB-264270/0; EPA-600/7-76-034d-Vol-4) Avail: NTIS HC A09/MF A01 CSCL 10A

Different methods of conserving energy in the petroleum refining industry are examined: (1) direct combustion of asphalt in process heaters and boilers, (2) hydrocracking of vacuum bottoms, (3) flexicoking of vacuum bottoms, (4) internal electrical power generation, and (5) hydrogen generation by partial oxidation. All are evaluated in terms of process economics and environmental/energy consequences. GRA

N77-26682# Little (Arthur D.), Inc., Cambridge, Mass.
ENVIRONMENTAL CONSIDERATIONS OF SELECTED ENERGY CONSERVING MANUFACTURING PROCESS OPTIONS. VOLUME 5: PULP AND PAPER INDUSTRY REPORT Final Report
Dec. 1976 206 p refs
(Contract EPA-68-03-2198)
(PB-264271/8; EPA-600/7-76-034e-Vol-5) Avail: NTIS HC A10/MF A01 CSCL 10A

Different production methods for the pulp and paper industry are examined in depth: (1) alkaline-oxygen pulping, (2) Rapson effluent-free kraft process, (3) thermomechanical pulping, and (4) deinking of old newsprint. All are evaluated in terms of *relative economics and environmental/energy consequences.* GRA

N77-26683# Little (Arthur D.), Inc., Cambridge, Mass.
ENVIRONMENTAL CONSIDERATIONS OF SELECTED ENERGY CONSERVING MANUFACTURING PROCESS OPTIONS. VOLUME 6: OLEFINS INDUSTRY REPORT
Dec. 1976 154 p
(Contract EPA-68-03-2198)
(PB-264272/6; EPA-600/7-76-034f-Vol-6) Avail: NTIS HC A08/MF A01 CSCL 10A

Relative process economics and environmental/energy consequences of both naphtha and atmospheric gas oil coil cracking are examined and compared with a base line plant using ethane-propane as a feedstock for producing olefins. *Emerging technologies for producing olefins are also briefly* analyzed. GRA

N77-26684# Little (Arthur D.), Inc., Cambridge, Mass.
ENVIRONMENTAL CONSIDERATIONS OF SELECTED ENERGY CONSERVING MANUFACTURING PROCESS OPTIONS. VOLUME 7: AMMONIA INDUSTRY REPORT Final Report
Dec. 1976 105 p
(Contract EPA-68-03-2198)
(PB-264273/4; EPA-600/7-76-034g-Vol-7) Avail: NTIS HC A06/MF A01 CSCL 10A

The production of ammonia based on coal gasification and the production of ammonia based on heavy oil gasification were analyzed in terms of process economics and environmental/energy *consequences.* GRA

N77-26685# Little (Arthur D.), Inc., Cambridge, Mass.
ENVIRONMENTAL CONSIDERATIONS OF SELECTED ENERGY CONSERVING MANUFACTURING PROCESS OPTIONS. VOLUME 8: ALUMINA/ALUMINUM INDUSTRY REPORT Final Report
Dec. 1976 155 p
(Contract EPA-68-03-2198)
(PB-264274/2; EPA-600/7-76-034h-Vol-8) Avail: NTIS HC A08/MF A01 CSCL 10A

New process developments for producing alumina from domestic clays as alternatives to the Bayer process were examined: (1) nitric acid leaching process, (2) hydrochloric acid leaching process, and (3) clay chlorination (such as the Toth alumina *process). The Alcoa chloride electrolysis process and the* application of titanium diboride cathodes to the conventional Hall-Heroult cells for the production of aluminum were also evaluated. All of these alternatives are discussed in terms of relative process economics and environmental/energy consequences. GRA

N77-26686# Little (Arthur D.), Inc., Cambridge, Mass.
ENVIRONMENTAL CONSIDERATIONS OF SELECTED ENERGY CONSERVING MANUFACTURING PROCESS OPTIONS. VOLUME 9: TEXTILE INDUSTRY REPORT Final Report
Dec. 1976 90 p refs
(Contract EPA-68-03-2198)
(PB-264275/9; EPA-600/7-76-034i-Vol-9) Avail: NTIS HC A05/MF A01 CSCL 10A

The environmental, energy, and economic impacts of three model technologies for the textile industry are examined. These include (1) integrated knot fabric mill using advanced processing of 100% polyester fiber, (2) integrated knit fabric mill using solvent processing of 100% polyester fiber, and (3) integrated woven fabric mill using advanced processing of 50/50 polyester cotton fiber mixture. All are evaluated in comparison with a base line technology representing the best of present textile industry practice. GRA

N77-26687# Little (Arthur D.), Inc., Cambridge, Mass.
ENVIRONMENTAL CONSIDERATIONS OF SELECTED ENERGY CONSERVING MANUFACTURING PROCESS OPTIONS. VOLUME 10: CEMENT INDUSTRY REPORT Final Report
Dec. 1976 132 p refs
(Contract EPA-68-03-2198)
(PB-264276/7; EPA-600/7-76-034j-Vol-10) Avail: NTIS HC A07/MF A01 CSCL 10A

The following process options for use in the cement industry are examined: (1) suspension preheater, (2) flash calciner, (3) fluid bed cement process, and (4) conversion to coal fuel from oil and natural gas. Process economics and environmental/energy consequences are considered. GRA

N77-26688# Little (Arthur D.), Inc., Cambridge, Mass.
ENVIRONMENTAL CONSIDERATIONS OF SELECTED ENERGY CONSERVING MANUFACTURING PROCESS OPTIONS. VOLUME 11: GLASS INDUSTRY Final Report
Dec. 1976 127 p refs
(Contract EPA-68-03-2198)
(PB-264277/5; EPA-600/7-76-034k-Vol-11) Avail: NTIS HC A07/MF A01 CSCL 10A

The following new process technologies and practices for the glass industry were evaluated in terms of their impact on relative process economics and their environmental/ energy consequences: (1) coal gasification, (2) direct coal firing, (3) electric melting, (4) coal, hot gas regeneration, and (5) batch preheating. GRA

N77-26689# Little (Arthur D.), Inc., Cambridge, Mass.
ENVIRONMENTAL CONSIDERATIONS OF SELECTED ENERGY CONSERVING MANUFACTURING PROCESS OPTIONS. VOLUME 12: CHLOR-ALKALI INDUSTRY REPORT Final Report
Dec. 1976 90 p refs
(Contract EPA-68-03-2198)
(PB-264278/3; EPA-600/7-76-034l-Vol-12) Avail: NTIS HC A05/MF A01 CSCL 10A

Processes for use in the chlor-alkali industry relating to diaphragm and mercury cell technology are considered, including dimensionally stable anodes, ion exchange membranes and stabilized asbestos diaphragms. These options are evaluated in terms of relative process economics and environmental/energy consequences. GRA

N77-26690# Little (Arthur D.), Inc., Cambridge, Mass.
ENVIRONMENTAL CONSIDERATIONS OF SELECTED ENERGY CONSERVING MANUFACTURING PROCESS OPTIONS. VOLUME 13: PHOSPHORIC ACID INDUSTRY REPORT Final Report
Dec. 1976 96 p refs
(Contract EPA-68-03-2198)
(PB-264279/1; EPA-600/7-76-034m-Vol-13) Avail: NTIS HC A05/MF A01 CSCL 10A

Different methods are evaluated for use in the phosphoric acid industry in terms of relative economics and environmental/energy consequences. These processes include (1) chemical cleanup of wet process phosphoric acid, (2) solvent extraction process for wet process phosphoric acid, (3) byproduct sulfuric acid for wet process phosphoric acid, and (4) strong acid system for wet process phosphoric acid. GRA

N77-26691# Little (Arthur D.), Inc., Cambridge, Mass.
ENVIRONMENTAL CONSIDERATIONS OF SELECTED ENERGY CONSERVING MANUFACTURING PROCESS OPTIONS. VOLUME 14: PRIMARY COPPER INDUSTRY REPORT Final Report
Dec. 1976 144 p refs
(Contract EPA-68-03-2198)
(PB-264280/9; EPA-600/7-76-034n-Vol-14) Avail: NTIS HC A07/MF A01 CSCL 10A

Several alternative processes are considered for use in the copper industry: (1) Outokumpu flash smelting, (2) Noranda process,(3) Mitsubishi process, (4) oxygen use in smelting, (5) metal recovery from slags (flotation or electric furnace), and (6) Arbiter process. All are evaluated in terms of relative economics and environmental/energy consequences. GRA

N77-26692# Little (Arthur D.), Inc., Cambridge, Mass.
ENVIRONMENTAL CONSIDERATIONS OF SELECTED ENERGY CONSERVING MANUFACTURING PROCESS OPTIONS. VOLUME 15: FERTILIZER INDUSTRY REPORT Final Report
Dec. 1976 74 p
(Contract EPA-68-03-2198)
(PB-264281/7; EPA-600/7-76-034o-Vol-15) Avail: NTIS HC A04/MF A01 CSCL 10A

The two major areas in the fertilizer industry in which energy conservation and pollution control are in conflict are examined; i.e. the reduction of nitrogen oxide emissions from nitric acid plants and switching from natural gas to fuel oil for firing fertilizer dryers where emissions are controlled by bag filters. GRA

N77-26693# Mathematical Sciences Northwest, Inc., Bellevue, Wash.
A SOCIAL AND ECONOMIC IMPACT STUDY OF OFFSHORE PETROLEUM AND NATURAL GAS DEVELOPMENT IN ALASKA, PHASE 2 Final Report
15 Oct. 1976 391 p refs Prepared in cooperation with Human Resources Planning Inst., Seattle and Alaska Consultants, Inc., Anchorage.
(Contract DI-08550-CT5-46)
(PB-264706/3; MSNW/AC-76-2074; BLM/SE-77-02-Pt-2) Avail: NTIS HC A17/MF A01 CSCL 10A

The major effort in the second phase of the study is the application of the modeling techniques used in Phase 1 to areas that have the potential for future hydrocarbon development and the projection of the nature and range of socio-economic impacts that could take place. The sites selected are located in regions that have been identified as having potentially large hydrocarbon reserves. GRA

N77-26696# Office of Naval Research, London (England).
INTERNATIONAL CONFERENCE ON HYDROGEN AND ITS PROSPECTS
W. G. Soper 31 Dec. 1976 23 p Conf. held at Liege, Belgium, 15-18 Nov. 1976
(AD-A036936; ONRL-C-49-76) Avail: NTIS HC A02/MF A01 CSCL 21/4

Papers from the international conference 'Hydrogen and its Prospects' Liege, Belgium, 15-18 1976, are reviewed for their contribution to future production and utilization of hydrogen as a fuel. Principal emphasis is placed upon the production of hydrogen by electrolysis and thermochemical decomposition of water, and upon the comparison of these processes with synthetic fuel production from fossil resources. Other topics discussed include hydrogen storage and its use as fuel in automobiles and aircraft. Author (GRA)

N77-26697# Illinois Univ., Urbana-Champaign. Center for Advanced Computation.
TECHNIQUES FOR THE ANALYSIS OF TOTAL ENERGY AND LABOR OF INDUSTRIAL PLANTS
Richard E. Klein, Hasan Sehitoglu, and Bruce M. Hannon May 1976 50 p refs
(Grant NSF SIA-72-03530)
(PB-264221/3; UIUC-CAC-DN-76-198; NSF/RA-760445) Avail: NTIS HC A03/MF A01 CSCL 10A

A method is developed for determination of the total energy (direct plus indirect) and the labor requirements to produce a unit of output from an industrial plant or facility. The total energy and labor requirements are determined by accounting for all energy and labor as the product or raw materials flow from the mine or other natural resource through all production and manufactures to a given production status. In this way, each manufacturing step is accounted for in its contribution to the total energy to produce a unit of product. GRA

N77-26698# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Renewable Resources for Industrial Materials.
THE POTENTIAL OF LIGNOCELLULOSIC MATERIALS FOR THE PRODUCTION OF CHEMICALS, FUELS, AND ENERGY
1976 99 p refs
(Contract NSF STP-75-10169)
(PB-264458/1; NSF/PRA-7501069-4-7) Avail: NTIS HC A05/MF A01 CSCL 07A

An energy policy is analyzed. For conservation of energy and materials the logical sequence of approaches to obtaining chemicals and polymers from lignocellulose is suggested as follows: (1) recovery of lignocellulosic chemicals from waste existing manufacturing operations now using these materials for other uses and from urban and agricultural solid waste, (2) conversion of cellulose, lignin and hemicelluloses and their derivatives into useful products taking advantage of their existing polymeric structure, and (3) conversion of cellulose, lignin and hemicelluloses into chemical intermediates which can be reassembled into useful polymers. GRA

N77-26703# Los Alamos Scientific Lab., N. Mex.
AEROSOL RESEARCH AND DEVELOPMENT RELATED TO HEALTH HAZARDS ANALYSIS Technical Report, 1 Jul. 1975 - 30 Jun. 1976
Lawrence W. Ortiz and Charles I. Fairchild Oct. 1976 21 p refs
(Contract W-7405-ENG-36; NIOSH-Proj. R072)
(LA-6539-PR) Avail: NTIS HC A02/MF A01

The particulate filtration efficiency of industrial gas-vapor sampler tubes was determined. This filtration efficiency is of interest for work environments containing toxic vapors and particulates of the contaminant, or inert particles containing adsorbed contaminant. The sampler tubes collect from 70-90 percent of the particles entering, but only 20 percent of the total is deposited on the active sorbent (charcoal granules). Considerable variability in collection efficiency between tubes was observed. Recommendations are made for obtaining improved contaminant estimates using these tubes. The preliminary design of a real-time particle sizing sampler for use in coal mines is described. ERA

N77-26708# Argonne National Lab., Ill.
AIR POLLUTION AND THE SITING OF FOSSIL FUEL POWER PLANTS
Gideon Fishelson, Gordon C. Rausser, and Alan S. Cohen Jul. 1976 12 p Prepared in cooperation with Chicago Univ., Ill.
(Contract W-31-109-eng-38; Grants NSF AG-352; NSF GI-32989-Az)
(ANL-76-XX-14) Avail: NTIS HC A02/MF A01

An analysis of the total social cost, and the trade-offs between generation/transmission and air pollution costs, for various types of fossil plants at different sites in northern Illinois are presented. The analysis identifies the combinations of site, fossil fuel, and sulfur dioxide (SO2) control technology that minimize total social costs. ERA

N77-26712# Oak Ridge National Lab., Tenn.
COMPARISON OF CALCULATED AND MEASURED MAXIMUM ABOVEGROUND AIR POLLUTANT CONCENTRATIONS AND THEIR RESPECTIVE DISTANCES FROM THE SOURCE OF RELEASE OF LARGE POWER PLANTS
Heinz Fortak Dec. 1969 18 p refs Transl. into ENGLISH from Staub-Reinhalt. Luft (Duesseldorf), v. 29, no. 12, Dec. 1969 p 493-498
(ORNL-TR-4231) Avail: NTIS HC A02/MF A01

A simplified version of the theory of atmospheric diffusion is applied to simulate maximum ground-level SO2 concentrations measured near large fossil fuel power plants. The results depend strongly on the special form of the plume rise formula. Neither Csanady's original formula nor the new optimized version of it gives satisfactory results. A slight modification of the exponent in the optimized Csanady-formula however seems to simulate the measurements in the best way. ERA

N77-26713# Brookhaven National Lab., Upton, N.Y.
OXIDATION OF SULFUR DIOXIDE IN POWER PLANT PLUMES
J. Forrest and Leonard Newman 1976 31 p refs Presented at the 69th Ann. Meeting of the AICHE, Chicago, 28 Nov. 1976
(Contract E(30-1)-16; EPA-IAG-D4-0391)
(BNL-21698; Conf-761109-5) Avail: NTIS HC A03/MF A01

The extent of oxidation of sulfur dioxide to sulfate was measured at two coal-fired and four oil-fired power plant plumes. Samples were collected at various distances downwind of the source by employing a high-volume filter pack in a fixed-wing aircraft. Particulate sulfur to total sulfur concentration ratios and S-34 to S-32 isotope ratios were measured and interpreted. In almost all instances essentially all of the oxidation was found to occur during the first few kilometers of plume transit and even when plumes were followed for more than 70 kilometers. In the coal-fired plumes the extent of oxidation seldom exceeded 4 percent, one-third of which could be attributed to primary sulfate production during the combustion of the coal. In the oil-fired plumes the extent of oxidation was approximately twice that observed for coal. ERA

N77-26787# Texas A&M Univ., College Station. Dept. of Oceanography.
PROCEEDINGS OF A WORKSHOP ON ENVIRONMENTAL OCEANOGRAPHY OF THE GULF OF MEXICO
1976 55 p Workshop held at College Station, Tex., 15-16 Mar. 1976
(Contract E(40-1)-5017)
(ORO-5017-1; Conf-760363) Avail: NTIS HC A04/MF A01

A workshop was convened to define the most critical energy-related environmental problems in the Gulf of Mexico and develop the framework for a program of research to solve these problems. A major and immediate concern is activity related to the oil and gas industry: production, transportation (including potential superport construction), processing, and use of petroleum-derived fuels. The problems which might be posed by the development of other potential sources of energy, such as coastal and offshore nuclear power plants, were also given consideration. ERA

N77-26816# Oak Ridge National Lab., Tenn. Energy Div.
INTERNALIZING SOCIAL COSTS IN POWER PLANT SITING: SOME EXAMPLES FOR COAL AND NUCLEAR PLANTS IN THE UNITED STATES
Elizabeth Peelle 1976 27 p refs Presented at the Am. Nuclear Soc. Intern. Meeting, Washington, D.C., 17 Nov. 1976 Sponsored in part by the US Nuclear Regulatory Commission
(Contract W-7405-eng-26)
(CONF-761103-16) Avail: NTIS HC A03/MF A01

Selected aspects of the United States experience in one particular type of energy development project, the siting of nuclear and fossil fueled power generating facilities, are examined in terms of how well community-level impacts are internalized. New institutional arrangements being devised and new requirements being made at local, state, regional, and federal levels in response to these dissociations of cost and benefits from large energy development projects are discussed. Selected examples of these new institutional responses are analyzed for adequacy and significance. ERA

N77-26916# Energy Research and Development Administration, Washington, D.C.
ENERGY AND PHYSICS
P. L. Kapitsa 1976 12 p refs Transl. into ENGLISH from Usp. Fiz. Nauk (USSR), v. 118, no. 2, 1976 p 307-314
(ERDA-TR-225) Avail: NTIS HC A02/MF A01

Hydrogen fuel cells are very efficient, but the extremely small rate of diffusion in electrolytes renders the energy density very small: for 100 MW of power the working area of electrodes reaches a square kilometer. Similar comments apply to direct conversion of solar energy into electricity. Solar power does not exceed 100 W/sq m, hence, to generate 100 MW one must take electricity from an area of one square kilometer, and not one of the methods of converting solar energy suggested so far can realize this such that capital expenditures can be justified. Costs must be reduced by several orders of magnitude; at least at present, the practical direct use of solar energy is unrealistic on a large scale. Use of geothermal energy requires very great areas at a depth of 10 to 15 km; the difficulties are such that the possibility of heating the required amount of water is in doubt. Damming rivers, except in mountains, and use of wind are also economically unjustified. Evidently nuclear energy is the only solution. ERA

N77-26977# Bechtel Corp., San Francisco, Calif.
EVALUATION OF THE TECHNICAL AND ECONOMIC FEASIBILITY OF MIRROR FUSION DEVICES Final Report
Aug. 1976 191 p refs
(Contract W-7405-eng-48)
(UCRL-13695) Avail: NTIS HC A09/MF A01

The following four task-reports are included: (1) cost analysis of potassium vapor topping cycle and conventional steam cycle, (2) heat transport and energy conversion system analysis and conceptual cost estimate, (3) plant arrangement, and reactor containment structural design and cost estimate, and (4) coil restraint structure conceptual design and cost estimate. Each of the reports is complete in itself with respect to the particular task concerned. ERA

N77-26987# Colorado Univ., Boulder.
APPLIED RESEARCH IN THE GENERAL AREA OF CHARGED PARTICLE CHEMISTRY RELATED TO COAL-FIRED MHD Progress Report, 1 Nov. 1975 - 30 Apr. 1976
D. W. Norcross, W. C. Lineberger, and E. C. Beaty 1976 117 p refs
(Grant NSF AER-74-20552)
(PB-263873/2; NSF/RA-760444) Avail: NTIS HC A06/MF A01 CSCL 07A

The three major components of the present program are measurement of the thermodynamic properties of some of the most important negative ions, development and application of theoretical techniques to the determination of the contribution to the plasma conductivity of the dominant polar molecules, and the provision of a comprehensive compilation of data on molecular electron affinities and on electron collisions with atomic and molecular species peculiar to the MHD plasma. GRA

N77-26988# Argonne National Lab., Ill. Engineering Div.
EXPERIMENTAL TWO-PHASE LIQUID-METAL MAGNETOHYDRODYNAMIC GENERATOR PROGRAM Annual Report, Aug. 1974 - Jul. 1975
M. Petrick, G. Fabris, R. Cole, R. Hantman, E. Pierson, and J. Cutting Nov. 1976 105 p refs
(Contract NAonr-16-76)
(AD-A035245; ANL-ENG-76-04) Avail: NTIS HC A06/MF A01 CSCL 10/2

A new diverging-channel liquid-metal MHD generator with gas injection along the insulating walls was built and placed in operation in late 1974. This generator yielded nearly-constant liquid velocity along the channel for near-design conditions, as desired for best performance. Extensive measurements of the generator terminal and internal parameters were made over a range of gas and liquid flow rates, magnetic field strengths, and load resistance values. Data are given for generator efficiency and load voltages, and the variations along the channel of liquid and gas velocities, pressure, local load factor, void fraction, and slip ratio. Comparisons are made with theoretical predictions. Tests made to evaluate the effectiveness of the gas injection indicated that the generator performance improved slightly as the amount of gas injected was decreased, and that the injected gas was not forming the desired pure-gas wall layer. Following this, air-water tests indicated that this was to be expected, and a one-dimensional computer model indicated that performance should be better without the partial flow obstruction of the gas injection ports. The gas injection ports were removed, and substantial improvement was obtained in generator performance - by far the best to date. Data comparable to that for gas injection is presented for this case. The future directions of the program, including the role of gas injection, and the modifications to the NaK-nitrogen facility are described. Author (GRA)

N77-26999# Airco, Inc., Murray Hill, N. J. Central Research Labs.
COMPARATIVE COST STUDY OF THE PROCESSES FOR PRODUCING NIOBIUM-TIN (Nb3 Sn) SUPERCONDUCTING TAPES FOR THEIR APPLICATION TO POWER TRANSMISSION LINES Final Report
Oct. 1976 106 p
(Contract PO-WA-76-4939)
(ERDA-76-160) Avail: NTIS HC A06/MF A01

The 14 product examples studied are produced by processes involving solid-state diffusion of Sn and Nb and/or physical vapor deposition. Production of 80,000 km per year is assumed, sufficient for 100 km of 3 phase ac line. Results are summarized in a table. The table identifies the 14 product examples by method of manufacture, by the composition of the layers integrated into the tape, and by the final thickness of Nb used in 12 of the product examples. The estimated fixed capital per plant is listed for each product example together with the estimated costs of manufacture in cents per meter of tape. The total manufacturing cost given is the sum of the costs of raw materials, operating labor, depreciation, and other overhead. ERA

N77-27020*# Battelle Columbus Labs., Ohio.
FACTORS AFFECTING THE CORPORATE DECISIONMAKING PROCESS OF AIR TRANSPORT MANUFACTURERS Final Report
R. G. Ollila, J. D. Hill, B. R. Noton, M. A. Duffy, and M. M. Epstein 15 Dec. 1976 118 p refs
(Contract NASw-2970)
(NASA-CR-154618) Avail: NTIS HC A06/MF A01 CSCL 05A

Fuel economy is a pivotal question influencing the future sale and utilization of commercial aircraft. The NASA Aircraft Energy Efficiency (ACEE) Program Office has a program intended to accelerate the readiness of advanced technologies for energy efficient aircraft. Because the decision to develop a new airframe or engine is a major financial hazard for manufacturers, it is important to know what factors influence the decision making process. A method is described for identifying and ranking individuals and organizations involved at each stage of commercial air transport development, and the barriers that must be overcome in adopting new technologies. A.R.H.

N77-27036# California Univ., Livermore. Lawrence Livermore Lab.
TRANSPORTATION-RELATED DATA BASES EXTRACTED FROM THE NATIONAL INDEX OF ENERGY AND ENVIRONMENTAL DATA BASES. PART 1: DIGEST OF DETAILED DATA BASE DESCRIPTIONS
E. W. Birss and J. W. Yeh 15 Nov. 1976 133 p
(Contract W-7405-eng-48)
(UCID-17316-Pt-1) Avail: NTIS HC A07/MF A01

Lawrence Livermore Laboratory (LLL) extracted a set of 135 transportation-related data bases from a computerized national index of energy and environmental data bases which LLL had produced for the Division of Biomedical and Environmental Research of the Energy Research and Development Administration. These 135 data bases, which relate to the intersection of the energy and transportation fields, initially served as a model for designing a questionnaire for transportation-related data bases and were subsequently converted into a DOT survey data base format. A digest and detailed description of each data base is presented. The format includes: data base name, administrative control and technical content personnel, data base category, coverage and availability, hardware/software environment, documentation and application, and abstract and objectives. ERA

N77-27037# California Univ., Livermore. Lawrence Livermore Lab.
TRANSPORTATION-RELATED DATA BASES EXTRACTED FROM THE NATIONAL INDEX OF ENERGY AND ENVIRONMENTAL DATA BASES. PART 2: DETAILED DATA BASE DESCRIPTIONS
E. W. Birss and J. W. Yeh 15 Nov. 1976 277 p
(Contract W-7405-eng-48)
(UCID-17316-Pt-2) Avail: NTIS HC A13/MF A01
For abstract, see N77-27036.

N77-27038# World Meteorological Organization, Geneva (Switzerland).
WEATHER, CLIMATE AND HUMAN SETTLEMENTS
H. E. Landsberg 1976 55 p
(WMO-448; SER-7; ISBN-92-63-10448-4) Avail: NTIS HC A04/MF A01

The role weather and climate play in urban planning and in the development of new settlements is described. In particular the following aspects are considered: weather disasters such as storms and floods; climate and energy use; climate and building construction; air pollution; climate and land use; climate and recreation; and the effects of urbanization on climate. ESA

N77-27057# Wisconsin Univ., Madison.
CALCULATION OF MONTHLY AVERAGE INSOLATION ON TILTED SURFACES

S. A. Klein 1976 14 p Presented at Joint Conf. of the Amer. Sect. of the Intern. Solar Energy Soc. and the Solar Energy Soc. of Canada, Inc., Winnipeg, Manitoba, Can., 15 Aug. 1976
(Contract EY-76-S-02-2588)
(CONF-760842-15) Avail: NTIS HC A02/MF A01

Several simplified design procedures for solar energy systems require monthly average meteorological data. Monthly average daily totals of the solar radiation incident on a horizontal surface are available. However, radiation data on tilted surfaces, required by the design procedures, are generally not available. A simple method of estimating the average daily radiation for each calendar month on surfaces facing directly towards the equator was presented. The method is verified with experimental measurements and extended to allow calculation of monthly average radiation on surfaces of a wide range of orientations. The results are presented in analytic and tabular form for latitudes ranging from 25 deg to 55 deg, surface azimuth angles of + or - 45 deg, and for collector slopes within the range of practical interest. ERA

N77-27104*# Boeing Vertol Co., Philadelphia, Pa.
IDENTIFYING AND ANALYZING METHODS FOR REDUCING THE ENERGY CONSUMPTION OF HELICOPTERS
S. Jon Davis and Harold J. Rosenstein Dec. 1976 22 p
(Contract NAS1-13624)
(NASA-CR-144953A) Avail: NTIS HC A02/MF A01 CSCL 01C

Reductions in helicopter energy consumption can be accomplished through the use of advanced technology in the areas of powerplant design, improved rotor efficiency, reduced parasite drag, and reduced structural empty weight. Baseline helicopters incorporating technology were designed for a short range (200 n mi) and a very short haul (100 n mi) mission scenario. Parametric analyses were then conducted to determine the impact of technology improvement. Many of the parameters varied are interrelated. A summary of such interactions is presented, and some additional sensitivity values were added so that energy reduction and DOC as affected by the major technological factors or operational modes are clearly defined. Author

N77-27152# Army Natick Research and Development Command, Mass.
***OPERATION OF MILITARY FIELD HEATING EQUIPMENT USING SOLID FUELS* Final Report**
Cornelius J. McKeown Mar. 1977 45 p refs
(AD-A037121; NARADCOM-TR-76-61-AMEL) Avail: NTIS HC A03/MF A01 CSCL 21/4

In view of the present energy crisis and its impact on the use of liquid fuel, this project was undertaken to survey the present military heating equipment to determine its capabilities for burning solid fuels. This report describes standard military equipment and components for heating in field operations with solid fuel. Included in the report is a discussion of the handling and burning characteristics of solid fuels. The report concludes with twenty-two recommendations that should be considered. The increasing demand of liquid fuel needed for military combat equipment plus the uncertain supply of liquid fuel could result in a drastic reduction in the amount of liquid fuel available for field heating. Author (GRA)

N77-27157*# Martin Marietta Corp., Denver, Colo.
ORBITAL CONSTRUCTION SUPPORT EQUIPMENT Final Report
Jun. 1977 437 p refs
(Contract NAS9-15120)
(NASA-CR-151460; MCR-77-234) Avail: NTIS HC A19/MF A01 CSCL 22A

Approximately 200 separate construction steps were defined for the three solar power satellite (SPS) concepts. Detailed construction scenarios were developed which describe the specific tasks to be accomplished, and identify general equipment requirements. The scenarios were used to perform a functional analysis, which resulted in the definition of 100 distinct SPS elements. These elements are the components, parts, subsystems, or assemblies upon which construction activities take place. The major SPS elements for each configuration are shown. For those elements, 300 functional requirements were identified in seven generic processes. Cumulatively, these processes encompass all functions required during SPS construction/assembly. Individually each process is defined such that it includes a specific type of activity. Each SPS element may involve activities relating to any or all of the generic processes. The processes are listed, and examples of the requirements defined for a typical element are given. Author

N77-27161*# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.
STUDY OF LYNDON B. JOHNSON SPACE CENTER UTILITY SYSTEMS
Tony E. Redding and William C. Huber Jun. 1977 127 p refs
(NASA-TM-58196) Avail: NTIS HC A07/MF A01 CSCL 14B

The results of an engineering study of potential energy saving utility system modifications for the NASA Lyndon B. Johnson Space Center are presented. The objective of the study was to define and analyze utility options that would provide facility energy savings in addition to the approximately 25 percent already achieved through an energy loads reduction program. A system engineering approach was used to determine total system energy and cost savings resulting from each of the ten major options investigated. The results reported include detailed cost analyses and cost comparisons of various options. Cost are projected to the year 2000. Also included are a brief description of a mathematical model used for the analysis and the rationale used for a site survey to select buildings suitable for analysis. Author

N77-27194# Oak Ridge Y-12 Plant, Tenn. Dept. of Fabrication Systems Development.
***COMPOSITE FLYWHEEL DEVELOPMENT* Technical Report, 1 May - 30 Jun. 1976**
R. L. Huddleston, J. J. Kelly, and C. E. Knight Jan. 1977 26 p refs
(Contract W-7405-eng-26)
(Y-2072) Avail: NTIS HC A03/MF A01

Composite flywheel program objectives and accomplishments for the period from May 1 through June 30, 1976 are summarized. Initial application selected for the development of the composite flywheel is the heat engine flywheel hybrid propulsion system for a vehicle, because of its high potential for the conservation of petroleum fuel in both the near and long range time frames. Efforts focused into key areas consistent with its experience base are: (1) state-of-the-art flywheel development, (2) spin testing, and (3) containment development. An operating performance goal of 20 watt hr/lb (20 Wh/lb) energy density at an energy level of 0.56 kWh was established. The 20 Wh/lb goal encompasses both the composite flywheel and the hub that connects it to the shaft. The goal exceeds the present performance of isotropic flywheels, and is also at the upper limit of current laboratory technology. ERA

N77-27242*# Kanner (Leo) Associates, Redwood City, Calif.
THERMAL STABILITY IMPROVEMENT OF DIESEL FUELS OF ISOPROPYLOCTADECYLAMINE
V. M. Shchagin and V. N. Zrelov Washington NASA Jun. 1977 6 p refs Transl. into ENGLISH from Neftepererabotka i Neftekhimiya (Moscow), no. 4, 1975 p 6-7
(Contract NASw-2790)
(NASA-TT-F-17300) Avail: NTIS HC A02/MF A01 CSCL 21D

The stability of the fuels was increased considerably by adding 0.05 wt.% isopropyl octadecylamine, giving no deposit after 4 hr heating at 150 deg. Loess dust (10 mg/ml fuel), introduced as road impurity into the fuel, had no effect on the stability. Author

N77-27243*# Scientific Translation Service, Santa Barbara, Calif.
EFFECT OF NITROGENOUS BASES ON THE THERMAL STABILITY OF JET FUELS

B. A. Englin, M. P. Alekseyeva, Zh. I. Gasanova, A. V. Isaev, G. B. Skovorodin, and S. M. Borisova Washington NASA Jul. 1977 6 p refs Transl. into ENGLISH from Nefteperera i Neftekhim. (Moscow), no. 3, 1973 p 9-11
(Contract NASw-2791)
(NASA-TM-75131) Avail: NTIS HC A02/MF A01 CSCL 21D

Fuels from naphthenic petroleums were evaluated, and it was found that they had more N bases than those paraffinic ones (0.00024 and 0.000009% N, respectively). The removal of the N bases improved significantly the thermal stability and reduced the residue formation during oxidation of the fuel. The improvement depended on both content and composition of the bases. Thus, fuels with similar content of N bases (0.00058% N) and thermal stability had oxidation residues of 17.5 and 5.6 and sol. gum of 13 and 1.5 mg/100 ml, before and after removing the N bases, respectively. Author

N77-27245# Energy Research and Development Administration, Bartlesville, Okla. Bartlesville Energy Research Center.
EXPERIMENTAL RESULTS USING METHANOL AND METHANOL/GASOLINE BLENDS AS AUTOMOTIVE ENGINE FUEL
J. R. Allsup Jan. 1977 87 p refs
(BERC/RI-76/15) Avail: NTIS HC A05/MF A01

Comparative emission and fuel energy economy data were generated using 1975 model vehicles adjusted for gasoline fuel and using gasoline and gasoline blended with 5 and 10 percent methanol: tests were made at temperatures of 20, 75, and 100 F on a chassis dynamometer in a climate controlled test chamber. Results suggest that emissions and fuel energy economy are generally affected to the extent that methanol addition affects air-fuel stoichiometry, fuel heat content, and fuel vapor pressure. Vehicle emissions and fuel economy were essentially unchanged during approximately 7,500 miles of road testing; no engine or fuel system component failures were encountered during that testing. Road octane measurements were made for the fuels containing 5, 10, and 15 percent methanol in base gasolines of 84, 87, and 91 research octane quality. Results show significantly better octane improvement in blending methanol with the lower octane fuels as compared with the improvement in blending with the higher octane fuels. GRA

N77-27246# Bureau of Mines, Bartlesville, Okla.
METHANOL AS AUTOMOTIVE FUEL. PART 1: STRAIGHT METHANOL
R. D. Gleming and T. W. Chamberlain 1976 24 p refs Presented at Automotive Eng. Congr. and Exposition, Detroit, 24 Feb. 1975
(CONF-750264-1) Avail: NTIS HC A02/MF A01

Methanol was studied as an automotive fuel using a single-cylinder research engine, a 4-cylinder 122-CID (2,000 cc) engine, and an 8-cylinder 350-CID engine. Results showed that when using methanol as fuel, the single-cylinder engine could operate leaner than the multicylinder engines. This difference is attributable to air-fuel mixture mal-distribution associated with the multicylinder engines. Steady-state fuel economy and emissions data are presented and discussed. Results indicate that fuel economy (on an energy input basis) using methanol fuel is about 5 percent improved as compared to gasoline fuel economy and with substantially lower nitrogen oxides emissions for methanol. ERA

N77-27247# McKee (Arthur G.) and Co., Cleveland, Ohio.
UTILIZATION OF LOW AND INTERMEDIATE BTU GAS FROM COAL FOR IRON ORE PELLETIZING
R. A. Ashworth, K. C. Vyas, and D. G. Bonamer Mar. 1977 283 p
(Contract DI-BM-J0255021)
(PB-264702/2; BM-OFR-36-77) Avail: NTIS HC A13/MF A01 CSCL 11F

Technical and economic feasibility of gasification of low rank solid fuels to provide fuel gas for firing iron ore pelletizing furnaces in northern Minnesota are discussed. Comparisons are made of several types of gasification facilities at individual pellet plants. Costs of retrofitting to grate kiln, traveling grate, and shaft type furnaces are compared. GRA

N77-27249# Oak Ridge National Lab., Tenn.
CRYOGENIC POWER TRANSMISSION TECHNOLOGY: CRYOGENIC DIELECTRICS Quarterly Report, 1 Apr. - 30 Jun. 1976
Dec. 1976 44 p refs
(Contract W-7405-eng-26)
(ORNL-TM-5608; QR-14) Avail: NTIS HC A03/MF A01

Partial discharge characteristics of three-layer polymer samples, impregnated with helium in a wide range of pressure and temperature (0.3-1.5 MPa and 4.2-12 K), are reported. Electrode-adjacent and mid-dielectric butt gaps are investigated. Results of PD measurements conducted on embossed films and on a sample with a shielded butt gap are discussed. Dc dielectric strength measurements on two layers of cellulose paper, impregnated by helium at 1 MPa and 12 K, are reported. Flashover problems, encountered with dc measurements on polymer films, are also summarized. Results of low temperature resistivity measurments made on a conducting paper are given. Experimental plans for the forthcoming and final quarter of the program are presented. ERA

N77-27311# Los Alamos Scientific Lab., N. Mex.
DESIGN OF MULTIFILAMENTARY Nb3Sn SUPERCONDUCTOR TAILORED TO THE REQUIREMENTS OF A DC SUPERCONDUCTING POWER TRANSMISSION LINE
H. L. Laquer 1976 13 p refs Presented at ASM Conf. on Manuf. of Superconducting Materials, Port Chester, N. Y., 8 Nov. 1976
(Contract W-7405-eng-36)
(LA-UR-77-99) Avail: NTIS HC A02/MF A01

There are at least four fundamentally different layouts for Cu-stabilized multifilamentary Nb3Sn superconductors. Multiple stacking further increases the possible permutations and combinations. The basic designs with respect to compound formation, stability, reduction of current transfer resistances, flexibility, and wire strain are analyzed. As a result, a very limited number of geometries for the conductor that will be suitable for use in the subcables of a dc superconducting power transmission line operating in the 10 to 14 K range and at the relatively low self-fields of 0.2 to 0.6 T are specified. ERA

N77-27312# Sandia Labs., Albuquerque, N. Mex.
THE 275 DEG C MICROCIRCUITRY: RESISTORS, CAPACITORS, CONDUCTORS, SUBSTRATES, AND BONDING
David W. Palmer and Glen L. Knauss Dec. 1976 60 p refs
(Contract E(29-1)-789)
(SAND-76-0611) Avail: NTIS HC A04/MF A01

Commercially available resistors, capacitors, substrates, conductors, and bonding techniques were tested over the temperature range of 25-300 C. Thick film resistors were found to have a total change in resistance of 1-5% from 25-300 C, and a resistance drift of less than 1% during 1,000 hours at 300 C. Several types of capacitors were found that showed total capacitance change from 25 to 300 C of about 5%, high temperature dissipation factors of less than 10%, 300 C insulation resistances of 10 megohm-microfarad, and high temperature lifetimes greater than 1,000 hours. Polyimide board with Ni plated Cu cladding, and alumina ceramic with thick film Pt-Au conductor paths were shown to be suitable for high temperature microcircuit frameworks. ERA

N77-27316# Gordian Associates, Inc., New York.
STRUCTURAL REFORM IN THE ELECTRIC POWER INDUSTRY Final Report
Feb. 1977 97 p refs
(Contract FEA-CO-05-50152-00)
(PB-264589/3; FEA/G-76/323) Avail: NTIS HC A05/MF A01 CSCL 13B

The long-term capability of the electric power industry and its associated regulatory institutions to operate efficiently and effectively under a wide range of possible demand conditions is investigated. GRA

N77-27326# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
HELIUM RESEARCH IN SUPPORT OF SUPERCONDUCTING POWER TRANSMISSION Annual Report, Jul. 1975 - Sep. 1976
M. C. Jones, V. D. Arp, W. R. Parrish, D. E. Daney, and P. R. Ludtke Feb. 1977 100 p refs
(Contract E(49-1)-3800)
(PB-265076/0; NBSIR-77-853; CONS-3800-1car-2) Avail: NTIS HC A05/MF A01 CSCL 09C

Results are presented from experimental and computer modeling of the performance of current leads cooled with supercritical helium gas. Performance characteristics studied are burn-out conditions and existence of oscillation in the helium gas. Conclusions are given on the feasibility of data transmission from high voltage regions to grounded read-out instrumentation, on thermometry, and on helium impurity measurements. Test results of microwave cavity pressure transducers for use at helium temperatures are discussed along with computer codes for helium properties and data on the thermal conductivity or helium. A flow facility built for research on flow and heat transfer dynamics of supercritical helium in channels of high aspect ratio modeling superconducting power transmission line channels is described. GRA

N77-27410# Chrysler Corp., Detroit, Mich.
BASELINE GAS TURBINE DEVELOPMENT PROGRAM Quarterly Progress Report
F. W. Schmidt and C. E. Wagner 30 Jul. 1976 50 p refs
(Contract E(11-1)-2749)
(COO-2749-15; QPR-15) Avail: NTIS HC A03/MF A01

An experimental gas turbine powered automobile was designed which would meet the 1978 Federal Emissions Standards, have significantly improved fuel economy and be competitive in performance, reliability and potential manufacturing cost with the conventional piston engine powered automobile. The baseline engine is a 4:1 pressure ratio regenerative engine with variable power turbine nozzles which meets the .41 HC, 3.4 CO; 3.0 NOx grams/mile original 1975 emissions standards. Baseline vehicles are intermediate-size, 4-door sedans modified to accept the turbine engines. Emissions tests using COED coal derived fuel were conducted. The first upgraded engine was assembled, installed in a test cell, and initial test runs up to 70% speed were conducted. Control of gas generator shaft instabilities was demonstrated by providing a low spring rate, squeeze film damping, and reducing the motion restraint caused by thrust loadings. The power turbine shaft dynamics fixture was run successfully to 60,000 rpm. ERA

N77-27474*# Kanner (Leo) Associates, Redwood City, Calif.
LANDSAT (ERTS) USED AS A BASIS FOR GEOLOGICAL VOLCANOLOGICAL MAPPING IN THE CENTRAL ANDES
S. Kussmaul and C. E. Brockman Washington NASA Jul. 1977 19 p refs Transl. into ENGLISH from Geol. Jahrb. (Hanover, W. Germany), v. A33, 1976 p 133-144
(Contract NASw-2790)
(NASA-TM-75024) Avail: NTIS HC A02/MF A01 CSCL 08G

LANDSAT images of the central Andes (N-Chile, W-Bolivia) were effectively used for volcanological mapping of an area about 160,000 km. The map shown exhibits more and better details than the older small scale geological maps of that area. Even on a scale of 1:1,000,000 details greater than 200 m in size are recognizable. The interpretation of LANDSAT images makes it possible to establish relative age sequences of strato-volcanoes. Finally, the images will also be helpful in prospecting for mineral deposits and geothermal sources. Author

N77-27493*# Raines (Jeremy K.), Bethesda, Md.
THEORETICAL ANALYSIS OF THE EWEC REPORT
30 Dec. 1976 100 p refs
(Contract NAS5-23641)
(NASA-CR-152542) Avail: NTIS HC A05/MF A01 CSCL 10A

This analytic investigation shows how the electromagnetic wave energy conversion (EWEC) device, as used for solar-to-electric power conversion, is significantly different from solar cells, with respect to principles of operation. An optimistic estimate of efficiency is about 80% for a full-wave rectifying configuration with solar radiation normally incident. This compares favorably with the theoretical maximum for a CdTe solar cell (23.5%), as well as with the efficiencies of more familiar cells: Si (19.5%), InP (21.5%), and GaAs (23%). Some key technological issues that must be resolved before the EWEC device can be realized are identified. Those issues include: the fabrication of a pn semi-conductor junction with no permittivity resonances in the optical band; and the efficient channeling of the power received by countless microscopic horn antennas through a relatively few number of wires. Author

N77-27496*# United Technologies Corp., South Windsor, Conn. Power Systems Div.
THERMAL BARRIER COATING ON HIGH TEMPERATURE INDUSTRIAL GAS TURBINE ENGINES Final Report
Nils Carlson and Barry L. Stoner (Pratt and Whitney Aircraft, East Harford, Conn.) Feb. 1977 60 p
(Contracts NAS3-20067; e(49-28)-1022)
(NASA-CR-135147; ERDA/NASA-0067/77/1; PSD-R-109) Avail: NTIS HC A04/MF A01 CSCL 10B

The thermal barrier coating used was a yttria stabilized zirconia material with a NiCrAlY undercoat, and the base engine used to establish improvements was the P&WA FT50A-4 industrial gas turbine engine. The design benefits of thermal barrier coatings include simplified cooling schemes and the use of conventional alloys in the engine hot section. Cooling flow reductions and improved heating rates achieved with thermal barrier coating result in improved performance. Economic benefits include reduced power production costs and reduced fuel consumption. Over the 30,000 hour life of the thermal barrier coated parts, fuel savings equivalent to $5 million are projected and specific power (megawatts/mass of engine airflow) improvements on the order of 13% are estimated. Author

N77-27497*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PHOTOVOLTAIC-POWERED REFRIGERATOR EXPERIMENT AT ISLE ROYALE NATIONAL PARK
A. F. Ratajczak Jun. 1977 32 p
(Contract E(49-26)-1022)
(NASA-TM-73703; E-9241; ERDA/NASA-1022/77/15) Avail: NTIS HC A03/MF A01 CSCL 10A

The use of a photovoltaic power system to operate an electric refrigerator at a trail construction camp at Isle Royale, Michigan is investigated. The use of P/V power for refrigeration in a remote installation is demonstrated. System design as well as predicted and measured system performance are presented. Author

N77-27498*# Scientific Translation Service, Santa Barbara, Calif.
SOLUBILIZATION OF COAL IN ORGANIC MEDIA
Ph. Lahaye and D. Decroocq Washington NASA Jul. 1977 44 p refs Transl. into ENGLISH from Rev. Inst. Fr. Petrole Ann. Combust. Liquides (Paris), v. 31, no. 1, Jan. - Feb. 1976 p 99-130 Original language document was announced as A76-46522
(Contract NAS7-100)
(NASA-TM-75151) Avail: NTIS HC A03/MF A01 CSCL 10B

The use of solvent extraction to solubilize coal is discussed. Simple extractions are described which are conducted at moderate temperatures to exclude extraneous chemical reactions which would lead to uncontrolled changes in the components of the treated coal. Sample preparation, extraction apparatus, and the determination of extract yield for different experiments are also described. D.M.L.

N77-27499# Committee on the Judiciary (U. S. House).
ENERGY INDUSTRY INVESTIGATION. PART 1: JOINT VENTURES
Washington GPO 1976 621 p refs Hearings before Subcomm. on Monopolies and Commercial Law of the Comm. on the Judiciary, 94th Congr., 1st and 2d Sess., 30 Jul., 4 Sep. 1975 (GPO-72-530) Avail: Subcomm. on Monopolies and Commercial Law

The Subcommittee on Monopolies hearing on recent gasoline price increases and antitrust commercial laws are presented.I.M.

N77-27500# Committee on the Judiciary (U. S. House).
ENERGY INDUSTRY INVESTIGATION. PART 2: INDUSTRY STRUCTURE
Washington GPO 1977 638 p refs Hearings before Subcomm. on Monopolies and Commercial Law of the Comm. on the Judiciary, 94th Congr., 1st Sess., 31 Jul., 10-11 Sep. 1975 (GPO-83-695) Avail: Subcomm. on Monopolies and Commercial Law

For Abstract, see N77-27499.

N77-27502*# Solarex Corp., Rockville, Md.
DEVELOPMENT OF A HIGH EFFICIENCY THIN SILICON SOLAR CELL
Joseph Lindmayer Aug. 1977 16 p Prepared for JPL
(Contracts NAS7-100; JPL-954290)
(NASA-CR-153905; QR-7; SX/105/7Q) Avail: NTIS HC A02/MF A01 CSCL 10A

Preparation for full scale operation of the pilot line included reduction of the back metallization coverage to reduce the differential thermal expansion of very thin cells, mapping excess injection current at low dark forward voltage, determining the radius of curvature for fracture as a function of silicon thickness, and determining absorptance/emittance ratios for thin silicon solar cells. Author

N77-27505*# Texas Instruments, Inc., Dallas.
AUTOMATED ARRAY ASSEMBLY TASK, PHASE 1 Annual Report
Bernard G. Carbajal Mar. 1977 111 p refs Prepared for JPL Sponsored in part by ERDA
(Contracts NAS7-100; JPL-954405)
(NASA-CR-153909; TI-03-77-17; ERDA/JPL-954405-77/4) Avail: NTIS HC A06/MF A01 CSCL 10A

An assessment of state-of-the-art technologies that are applicable to silicon solar cell and solar cell module fabrication is provided. The assessment consists of a technical feasibility evaluation and a cost projection for high-volume production of silicon solar cell modules. The cost projection was approached from two directions; a design-to-cost analysis assigned cost goals to each major process element in the fabrication scheme, and a cost analysis built up projected costs for alternate technologies for each process element. A technical evaluation was used in combination with the cost analysis to identify a baseline low cost process. A novel approach to metal pattern design based on minimum power loss was developed. These design equations were used as a tool in the evaluation of metallization technologies. Author

N77-27506# Virginia Univ., Charlottesville. Dept. of Mechanical Engineering.
ENGINEERING ANALYSIS AND TESTING OF WATER-TRICKLE SOLAR COLLECTOR Annual Progress Report, Jun. 1975 - May 1976
J. Taylor Beard Jun. 1976 35 p refs
(Contract E(40-1)-4927)
(ORO-4927-76-2; Rept-2) Avail: NTIS HC A03/MF A01

An outdoor solar collector facility has been developed at the University of Virginia for the purpose of conducting a thermal performance evaluation of the Thomason SOLARIS water-trickle solar collector panels. A near linear relationship of efficiency is displayed as a function of the difference between inlet water temperature and the ambient temperature, divided by the incident solar energy. The significant scatter in the data results from other variables which are analyzed and include glazing cleanliness, angle of incidence, water evaporation and condensation, wind condition, and the influence of condensate droplets on the overall solar energy transmitted to the absorbing surface. The performance of the SOLARIS water-trickle collector is compared with published results for conventional single and double flat-plate collectors. ERA

N77-27507# Energy Research and Development Administration, Washington, D.C.
ENERGY SOURCES FOR TOMORROW
M. Meliss 1976 17 p Transl. into ENGLISH from West German Report, 1976 17 p
(ERDA-tr-226) Avail: NTIS A02/MF A01

The regenerative sources of solar energy, wind, energy from the seas, earth heat, and running water were investigated by a consortium of major research installations. The sources were assessed first on a global basis, then more specifically for the German Federal Republic. This paper summarizes results from the complete study, but devoted mostly to an analysis of utilization of wind energy, using the following topics: physical bases and theoretical potential, wind energy installations and technically useful potential, utility aspects, and recommendations for research and development work. ERA

N77-27508# United Technologies Corp., South Windsor, Conn. Power Systems Div.
ADVANCED TECHNOLOGY FUEL CELL PROGRAM Final Report
Joseph M. King, Jr. Oct. 1976 107 p refs Sponsored by EPRI
(EPRI-EM-335) Avail: NTIS HC A06/MF A01

Hydrodesulfurization of naphtha was adapted to fuel cell conditions; catalyst endurance and ability to use naphthas from a range of U.S. refineries were demonstrated. A 520-hour test demonstrated the technical feasibility of operating on No. 2 fuel oil. A study of centralstation coal powerplants showed integrated powerplants consisting of a gasifier, fuel cell, and bottoming cycle, provide estimated overall efficiencies of 40 percent for plants based on the phosphoric-acid cell and of 50 percent or higher for powerplants based on the molten-carbonate cell. ERA

N77-27509# Illinois Univ., Urbana. Center for Advanced Computation.
ENERGY USE FOR BUILDING CONSTRUCTION Progress Report, 1 Mar. - 1 Aug. 1976
B. M. Hannon, R. G. Stein, B. Segal, D. Serber, and C. Stein Aug. 1976 83 p refs
(Contract E(11-1)-2791)
(COO-2791-2) Avail: NTIS HC A05/MF A01

Total (direct and indirect) energy requirements of the construction industry were determined in order to examine the potential for energy savings. The Energy Input/Output Model developed was expanded to include a detailed breakdown of the industry and energy intensities of 49 building construction (new and maintenance) sectors and of the overall building construction industry were determined. ERA

N77-27510# General Electric Co., Schenectady, N.Y. Electrochemistry Branch.
DEVELOPMENT OF SODIUM-SULFUR BATTERIES FOR UTILITY APPLICATION Annual Report
D. Chatterji Dec. 1976 248 p refs Sponsored by EPRI
(EPRI-EM-266) Avail: NTIS HC A11/MF A01

The development of a sodium-sulfur battery system for bulk storage of energy is described. Two initial cell/module/system designs are discussed. The cell in these preliminary designs consists of many individual beta-alumina tubes used as the separator between single sodium and sulfur compartments. Heat conduction experiments were made and a complete thermal analysis of the system is given. A statistical analysis of the effects of failure or change in performance of individual cells or

modules and a study on optimization of the system cost were performed. ERA

N77-27511# Brookhaven National Lab., Upton, N. Y.
ENERGY MANAGEMENT IN RESIDENTIAL AND SMALL COMMERCIAL BUILDINGS Annual Report
John Batey, V. Gazerro, F. J. Salzano, and A. L. Berlad Jul. 1976 54 p refs
(Contract EY-76-C-02-0016)
(BNL-50576) Avail: NTIS HC A04/MF A01

Efficiency measurements performed on conventional residential oil-fired hot water heating equipment, including both steady state and cyclic (part load) efficiency determinations are described. A list of preliminary recommendations for retrofit actions to improve efficiency is provided. A summary of work carried out in the areas of thermal storage media, fenestration, and building thermal dynamics is also presented. ERA

N77-27513# Oak Ridge National Lab., Tenn.
SURVEY OF TECHNOLOGY FOR STORAGE OF THERMAL ENERGY IN HEAT TRANSFER SALT
M. D. Silverman and J. R. Engel 18 Jan. 1977 26 p refs
(Contract W-7405-eng-26)
(ORNL-TM-5682) Avail: NTIS HC A03/MF A01

Several specific energy storage applications, such as intermediate-load and peaking electric power, solar energy, and energy from fluidized-bed coal burners, are discussed. Long-term stability and corrosion data on these salts are presently available only to approximately 480 C. However, for the design and construction of energy storage facilities to operate over many years at temperatures up to approximately 540 C, long-term tests of thermal stability and corrosion are needed. Means for obtaining such information are proposed. ERA

N77-27516# Public Service Electric and Gas Co., Newark, N. J.
ECONOMIC ASSESSMENT OF THE UTILIZATION OF FUEL CELLS IN ELECTRIC UTILITY Final Report
William Wood, Murty P. Bhavaraju, and Paul Yatcko Nov. 1976 113 p Sponsored by EPRI
(EPRI-EM-336) Avail: NTIS HC A06/MF A01

The relationships between market penetration, fuel price, and capital cost for the two fuel cell types are discussed. In addition, the various penalties and savings that might occur to a utility through the installation of fuel cells are quantified. ERA

N77-27519# Energy Research and Development Administration, Grand Forks, N. Dak.
TECHNOLOGY AND USE OF LOW-RANK COALS IN THE USA
Gordon H. Gronhovd and Everett A. Sondreal 1976 43 p refs Presented at the Seminar on Technol. for the Util. of Low Calorie Fuels, Varna, Bulgaria, 20-22 Apr. 1976
(CONF-760495-1) Avail: NTIS HC A03/MF A01

The use of low-rank coals for power production and some of the related problems are discussed. Ash fouling of boiler tubes is the most serious operating problem. Research and commercial experience has shown fouling to be directly related to sodium and ash contents of the coals. Many of the US low-rank coals are relatively high in Na and require very conservative boiler designs. Boiler and fuel specifications are given for three recent plants of the 400 to 550 MW range designed to burn high-fouling lignites. ERA

N77-27520# Oak Ridge National Lab., Tenn.
COAL CONVERSION: DESCRIPTION OF TECHNOLOGIES AND NECESSARY BIOMEDICAL AND ENVIRONMENTAL RESEARCH
Aug. 1976 302 p refs
(Contract W-7405-eng-26)
(ORNL-5192) Avail: NTIS HC A14/MF A01

A description of the biomedical and environmental research necessary to ensure the timely attainment of coal conversion technologies amenable to man and his environment is presented. Topics are reviewed in sections. Section one studies: (1) types of processes currently being considered for development; (2) data currently available on composition of produce, (3) process and product streams, and their potential effects, (4) and problems that might arise from transportation and use of products. Section two is concerned with a description of the necessary research in each of the King-Muir categories, while the third section presents the research strategies necessary to assess the potential problems at the conversion plant (site specific) and those problems that might effect the general public and environment as a result of the operation of largescale coal conversion plants. ERA

N77-27521# Science Applications, Inc., McLean, Va.
SUPPLY OF LIQUEFIED NATURAL GAS TO THE NORTHEAST
G. R. Bray, S. K. Julin, and J. A. Simmons Apr. 1976 103 p refs
(Contract E(30-1)-16)
(BNL-50556) Avail: NTIS HC A06/MF A01

The following aspects of the supply of liquefied natural gas to the northeastern part of the U.S. are discussed: major facilities and equipment, institutional considerations and environmental impacts, site selection criteria, time required to implement an LNG (liquefied natural gas) project, projected availability and reliability of supply, projection of future imports to the northeast region, cost projections, and secondary benefits. ERA

N77-27526# AiResearch Mfg. Co., Phoenix, Ariz.
PRELIMINARY FAILURE MODES, EFFECTS AND CRITICALITY ANALYSIS (FMECA) OF THE BRAYTON ISOTOPE POWER SYSTEM (BIPS) GROUND DEMONSTRATION SYSTEM
L. G. Miller 1 Jun. 1976 47 p refs
(Contract EY-76-C-03-1123)
(TID-27301; AiResearch-76-311965) Avail: NTIS HC A03/MF A01

A Failure Modes, Effects and Criticality Analysis (FMECA) was made of the Brayton Isotope Power System Ground Demonstration System (BIPS-GDS). Details of the analysis are discussed. The BIPS-FS FMECA was reviewed and determined to be essentially current. ERA

N77-27527# California Univ., Livermore. Lawrence Livermore Lab.
WIND POWER STUDIES: REGIONAL WIND ENERGY MEASUREMENTS Progress Report, Jul. - Sep. 1976
Donald M. Hardy 1 Nov. 1976 12 p refs
(Contract W-7405-eng-48)
(UCRL-50034-76-4) Avail: NTIS HC A02/MF A01

The wind power field measurement program which is being conducted in conjunction with numerical analyses of regional wind energy is discussed. Early examples of data collected in the program are given, including data confirming the existence of a broad area of high wind speeds which were predicted in previous numerical analyses. The measurement program is described, and plans for further numerical analysis and the continuation of the measurement program are discussed. ERA

N77-27533# Wisconsin Univ., Madison.
PARAMETRIC STUDY OF CRITICAL FUEL COSTS FOR SOLAR HEATING IN NORTH AMERICA
J. A. Duffie, W. A. Reckman, and M. J. Brandemuehl 1976 13 p Presented at Joint Conf. of the Amer. Sec. of the Intern. Solar Energy Soc. and the Solar Energy Soc. of Canada, Inc., Winnipeg Manitoba, Canada, 15 Aug. 1976
(Contract EY-76-S-02-2588)
(CONF-760842-12) Avail: NTIS HC A02/MF A01

Critical fuel energy cost, C/sub F/, is defined as the cost of delivered energy from conventional sources below which heat from optimized solar systems is more expensive than heat from conventional sources. The critical fuel energy cost is a useful index to assess the feasibility of solar heating in any location or region. A method is presented for estimating C/sub F/ fo

particular locations, buildings, solar collectors, and solar heating system costs. Tables are presented which permit determination of C/sub F/ as a function of system costs for 96 stations in the United States and Canada. Examples of C/sub S/ are shown for two of these stations. ERA

N77-27534# Wisconsin Univ., Madison. Solar Energy Lab.
SIMULATION STUDY OF SEVERAL SOLAR HEATING SYSTEMS WITH OFFPEAK AUXILIARY
P. J. Hughes, W. A. Beckman, and J. A. Duffie 1976 19 p refs Presented at Joint Conf. of the Amer. Sec. of the Intern. Solar Energy Soc. and the Solar Energy Soc. of Canada, Inc., Winnipeg, Manitoba, Canada, 15 Aug. 1976
(Contract EY-76-S-02-2588)
(CONF-760842-13) Avail: NTIS HC A02/MF A01

Solar air heating systems are compared using simulation methods. Two basic types of offpeak systems have been studied; Systems 1 and 2 which separate the storage of auxiliary and solar energy, and Systems 3 and 4, which store all energy in the same pebble bed. Simulation methods are used to determine the effect of system configuration, collector loss coefficient, controls, storage size and collector flow rate on system performance. ERA

N77-27535# Wisconsin Univ., Madison. Solar Energy Lab.
REVIEW OF SOLAR COOLING
J. A. Duffie and W. A. Beckman 1976 14 p refs Presented at Joint Conf. of the Amer. Sect. of the Intern. Solar Energy Soc. and the Solar Energy Soc. of Canada, Inc., Winnipeg, Manitoba, Canada, 15 Aug. 1976
(Contract EY-76-S-02-2588)
(CONF-760842-9) Avail: NTIS HC A02/MF A01

The future of cooling is linked to component (collector and storage) development. It is also closely interrelated with developments in solar heating as the economics of the two processes appear to be better than that of either one alone. ERA

N77-27536# Argonne National Lab., Ill.
DESIGN PROBLEMS ASSOCIATED WITH THE USE OF EVACUATED GLASS RECEIVERS FOR SOLAR COLLECTORS
J. W. Allen, W. S. Schertz, and N. M. Levitz 1976 18 p refs Presented at 21st Symp. of the Amer. Sci. Glassblowers Soc., Chicago, Ill., 7 Jun. 1976
(Contract W-31-109-eng-38)
(CONF-7606128-1) Avail: NTIS HC A02/MF A01

The design of evacuated receivers being used with a compound parabolic concentrator (CPC) is discussed, and means of minimizing optical and thermal losses are described. Emphasis is placed on the identification of problems that need attention by the glass industry. An evacuated receiver designed for use with a lightweight, thermoformed plastic 3x CPC is used as an example. ERA

N77-27538# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
GEOTHERMAL R AND D PROJECT Technical Report, 1 Apr. - 30 Jun. 1976
J. F. Kunze, ed. Oct. 1976 59 p refs
(Contract EY-76-C-07-1570)
(TREE-1008) Avail: NTIS HC A08/MF A01

Progress during April to July 1976 in research on geothermal energy is reported. The experiments are performed in the Raft River Valley, Idaho, a hydrothermal resource site with water temperatures below 150 C. During this period, a third well, RRGE-3 was drilled, and well production was tested, testing of a direct contact heat exchanger continued, design and cost estimating continued on a 40 MW (th) organic-binary heat exchange facility, agricultural studies of irrigation with geothermal water progressed, and down-hole data was obtained from RRGE-3. ERA

N77-27539# General Atomic Co., San Diego, Calif.
GAS TURBINE HTGR PROGRAM Quarterly Progress and Task Closeout Report, for period ending 30 Sep. 1976
Oct. 1976 248 p refs
(Contract E(04-3)-0167)
(GA-A-14097) Avail: NTIS HC A11/MF A01

A status summary of the research and development of the power plant is presented. The basis for the performance estimates at 850 C and 950 C core outlet temperatures, overall plant efficiency of over 50 percent for the latter case as a binary-cycle plant, and component design requirements for the elevated temperature case and the conceptual designs at various ammonia bottoming-cycle components are described. A review of plant safety is presented, including that for the binary-cycle plant. Mechanically and aerodynamically improved designs for the turbomachines are described, based upon test data from the FT-50 engine, from use of a welded turbine rotor, from mounting two compressor stages per disk, and from alternate material selection. Studies of a core having an outlet temperature of 950 C and favorable conversion ratio and neutronics are described. Control studies, fission product plateout studies, and material testing in helium are summarized. Balance-of-plant layouts and requirements are described. Advances in PCRV and internals are discussed. The status of heat exchangers and control valves is reviewed. ERA

N77-27540# Wisconsin Univ., Madison.
PERFORMANCE OF A SOLAR HEATING SYSTEM UTILIZING PHASE-CHANGE ENERGY STORAGE
D. J. Morrison and S. I. Abdel-Khalik 1976 14 p refs Presented at Joint Conf. of the Amer. Sec. of the Intern. Solar Energy Soc. and the Solar Energy Soc. of Canada, Inc., Winnipeg, Manitoba, Canada, 15 Aug. 1976
(Contract EY-76-S-02-2588)
(CONF-760842-11) Avail: NTIS HC A02/MF A01

A model describing the transient behavior of a phase-change energy storage (PCES) unit is presented. Simulation techniques are used in conjunction with this model to determine the performance of a solar air-heating system utilizing PCES. The effects of storage size and heat transfer characteristics on the system performance are investigated. Optimum ranges of storage sizes are given for systems with paraffin wax and sodium sulfate decahydrate as storage media. Comparison is made between two similar systems with sensible heat and solar-supplied fraction of the load over the heating season are given for both systems. Actual weather data for the Madison area are used in these simulations. ERA

N77-27541# Sandia Labs., Albuquerque, N. Mex.
NONBIOLOGICAL PHOTOCHEMICAL ENERGY CONVERSION, CAN IT COMPETE
R. W. Harrigan 1976 24 p refs Presented at Amer. Chem. Soc. Pacific Conf., Phoenix, Ariz., 7 Nov. 1976
(Contract E(29-1)-789)
(SAND-76-5763; Conf-761135-1) Avail: NTIS HC A02/MF A01

The results of an analysis of a combined photovoltaic/thermal system applied to meeting a community energy demand are reported. ERA

N77-27542# Federal Energy Administration, Washington, D. C. Office of Coal Utilization.
COAL CONVERSION PROGRAM. ENERGY SUPPLY AND ENVIRONMENTAL COORDINATION ACT (AS AMENDED). SECTION 2
Feb. 1977 622 p refs
(PB-265815/1; FEA/G-77/061; DES-77/3) Avail: NTIS HC A99/MF A01 CSCL 13B

The Federal Energy Administration's authorities under ESECA are discussed. These include prohibiting fossil fuel fired facilities from burning natural gas or petroleum products as their primary energy source. The agency also has the power to require facilities in the early planning process to be built with the capability of burning coal. The probable environmental impacts associated with issuing such orders are considered. GRA

N77-27545# Argonne National Lab., Ill. Solar Energy Group.
INSTRUMENTATION FOR MEASURING DIRECT AND DIFFUSE INSOLATION IN TESTING THERMAL COLLECTORS
Kent A. Reed 1976 11 p refs Presented at 20th Ann. SPIE Tech. Symp. on the Appl. and Util. of Opt., Electro-Opt., Laser and Phot. Technol., San Diego, Calif., 23-27 Aug. 1976
(Contract W-31-109-eng-38)
(CONF-760832-23) Avail: NTIS HC A02/MF A01

The use of pyranometers to measure the total insolation as well as the insolation within specified angular fields of view, together with a normal incidence pyrheliometer to measure the direct beam component, is described. The instrument calibration procedure is discussed, and data are presented. ERA

N77-27546# Battelle Pacific Northwest Labs., Richland, Wash.
OPTIMIZATION TECHNIQUE FOR GEOTHERMAL POWER PLANTS USING A BINARY FLUID CYCLE
S. W. Wilson and R. A. Walter Oct. 1976 33 p refs
(Contract EY-76-C-06-1830)
(BNWL-2155) Avail: NTIS HC A03/MF A01

A comprehensive computer model of a binary fluid cycle power plant for use with geothermal resources was developed. This computer model can be used to assess the technical and economic feasibility of the geothermal resource and to aid in the design of binary power plants. An optimization technique was developed to rapidly select the power plant design with the highest utilization efficiency based upon the maximum use of available energy in the geothermal field. This optimization technique has shown a close correlation with the minimum cost of power and can be used to easily select a minimum cost geothermal plant design knowing the geothermal fluid temperature, the prevailing ambient temperature for heat rejection, and the selected working fluid. ERA

N77-27547# Argonne National Lab., Ill. Energy and Environmental Systems Div.
ASSESSMENT OF ENERGY STORAGE TECHNOLOGIES AND SYSTEMS. PHASE 1: ELECTRIC STORAGE HEATING, STORAGE AIR CONDITIONING, AND STORAGE HOT WATER HEATERS
J. Asbury, R. Giese, S. Nelson, L. Akridge (TRW Energy Systems Group, McLean, Va.), P. Graf (TRW Energy Systems Group, McClean, Va.), and K. Heitner (TRW Energy Systems Group, McLean, Va.) Aug. 1976 78 p refs
(Contract W-31-109-eng-38)
(ANL-ES-54) Avail: NTIS HC A05/MF A01

The commercial feasibility of thermal energy storage (TES) in buildings is analyzed. TES applications examined include storage electric (resistance) heating, storage air conditioning, and storage hot water heating. A system model, SIMSTOR, is employed to simulate TES-related effects upon daily and annual utility load profiles and to compare utility fuel and capital cost savings with TES-system costs. Case-study analyses of TES applications for a representative set of utility service areas indicate that several already and near-commercial TES systems are cost-effective. Alternative strategies to commercialize these systems are examined and the preferred strategies are identified. ERA

N77-27548# California Univ., Livermore. Lawrence Livermore Lab.
HYDROGEN STORAGE BY BINARY AND TERNARY INTERMETALLICS FOR ENERGY APPLICATIONS: A REVIEW
H. W. Newkirk 2 Aug. 1976 98 p refs Supersedes UCRL-51244
(Contract W-7405-eng-48)
(UCRL-52110; UCRL-51244) Avail: NTIS HC A05/MF A01

Binary and ternary intermetallic compounds are being considered as a possible solution to storage problems in the use of hydrogen as an alternative fuel for many applications. For selected systems, this report reviews and summarizes theories of storage optimization, experimental procedures, property data, potential applications for stationary and mobile energy storage, resource and economic analyses, and safety factors. The systems surveyed are those binary, ternary, and complex intermetallic compounds containing a member of the transition element series, a member of the rare earth series, and/or a member of the actinide series. ERA

N77-27549# Wilson, Jones, Morton and Lynch, San Mateo, Calif.
SANTA CLARA, CALIFORNIA, COMMUNITY CENTER, COMMERCIAL SOLAR DEMONSTRATION LEGAL ALTERNATIVES, IMPLICATIONS, AND FINANCING OF SOLAR HEATING AND COOLING BY A MUNICIPAL CORPORATION
Sharon S. White, T. S. Owen, R. A. Ryan, T. A. Scott, S. F. Lucey, K. I. Jones, and P. D. Assaf Sep. 1976 135 p refs Sponsored in part by the City of Santa Clara
(Contract E(04-3)-1083)
(SAN/1083-76/1) Avail: NTIS HC A07/MF A01

The legal issues confronting municipal corporations who propose to provide for solar energy utilization within their jurisdictions are many. Generally, however, such issues may be resolved in favor of most proposed forms of utilization based upon traditional legal principles. Threshold issues confronting any municipal utilization relate to the impact purpose. Previous judicial decisions indicate that an action by a private utility against a municipal corporation based upon impairment of contract, taking of property without compensation, unfair competition or antitrust violation would not be successful. ERA

N77-27550# Martin Marietta Corp., Denver, Colo.
CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM, PHASE 1 Final Quarterly Progress Report, period ending 31 Mar. 1976
Oct. 1976 118 p
(Contract E(04-3)-1110)
(SAN/1110-76/1; MCR-76-131) Avail: NTIS HC A06/MF A01

Both twenty-five mirror and nine mirror heliostats were designed for the collector subsystem. The detail design of the 5 MW research experiment receiver was further developed. A preliminary draft of the detailed test plan for the receiver subsystem research experiment was prepared and the detailed design of the thermal storage subsystem continued. A preliminary environmental analysis was completed for the pilot plant. Optimization studies of the electrical power generation system were initiated. A preliminary cost analysis was prepared for the 10 MWe central receiver solar thermal pilot plant. This task required the development of a cost accounting structure and a definition of all of the costs associated with the design, construction, checkout, and two year test of the pilot plant. ERA

N77-27551# Martin Marietta Corp., Denver, Colo.
CENTRAL RECEIVER SOLAR THERMAL POWER SYSTEM, PHASE 1 Final Quarterly Progress Report, period ending 30 Jun. 1976
Oct. 1976 128 p
(Contract E(04-3)-1110)
(SAN/1110-76/2; MCR-76-296) Avail: NTIS HC A07/MF A01

Effort was continued in the evaluation of pilot plant start transients. Both warm and hot starts from thermal storage were evaluated as was a cold start from the receiver. In the collector subsystem experiment, the heliostat structures and drive mechanisms were completed and delivered. The detail design of the 5 MW receiver experimental was completed. In the thermal storage subsystem the detail design of the experiment was completed. A final selection of the heat transport media was made with Hitec selected as the molten salt and Caloria HT-43 selected as the hydrocarbon oil. Bechtel continued its efforts in the optimization of the electrical power generation subsystem. ERA

N77-27553# Sandia Labs., Albuquerque, N. Mex.
HYDROGEN COMPATIBILITY OF STRUCTURAL MATERIALS FOR ENERGY STORAGE AND TRANSMISSION APPLICATIONS. Semiannual Report, period ending 1 Oct. 1976
S. L. Robinson, comp. Dec. 1976 69 p refs
(Contract E(29-1)-789)
(SAND-76-8255) Avail: NTIS HC A04/MF A01

The suitability of commercial alloys for containment of hydride-dehydride reactions was assessed, and recommendations for materials selection based upon tensile and slow crack growth tests were made. A series of in situ test specimens was prepared for exposure to a cyclic iron-titanium hydride environment. A preliminary welding specification for containment of hydrogen in structural mild steels was developed. Hydrogen permeation resistant coatings, applied by pyrolysis of silane and brush electroplating, were developed. Environmentally assisted, cyclic fatigue in high pressure hydrogen was identified as a potential hazard to the integrity of flawed pressure vessels in materials where slow crack growth under a constant load is not expected. ERA

N77-27554# Waterloo Univ. (Ontario).
STUDIES ON METHODS OF REDUCING HEAT LOSSES FROM FLAT PLATE SOLAR COLLECTORS Progress Report, 1 Aug. 1974 - 31 Jan. 1976
K. G. T. Hollands, G. D. Raithby, and T. E. Unny Jun. 1976 137 p refs
(Contract E(11-1)-2597)
(COO-2597-2) Avail: NTIS HC A07/MF A01

Improvements to flat plate solar collectors for heating and cooling of buildings were evaluated through three parallel studies. The first study has demonstrated suppression of free convection by a honeycomb at all angles of inclination. Reductions by a factor of 5 in the free convective heat loss are reported, and equations and charts permitting the rational design of honeycombs for convection suppression in solar collectors are presented. The second study has resulted in a precise, easily programmable set of equations for the free convective heat loss through the air gaps in flat plate solar collectors, for any angle of tilt. The third study has theoretically and experimentally demonstrated that the solar transmittance of a flat transparent cover for a solar collector can be very substantially increased by V-corrugating. Since V-corrugating should also decrease the free convective and radiant losses, substantial improvements in collector efficiency are predicted. ERA

N77-27559# Federal Energy Administration, Washington, D. C. Office of Management and Administration.
[MID-TERM AND LONG TERM ENERGY TRENDS] Annual Report, 1975 - 1976
Jan. 1977 164 p
(PB-264740/2; FEA/F-77/089) Avail: NTIS HC A08/MF A01 CSCL 10A

Positive energy accomplishments for the Nation and her citizens in Fiscal Year 1976 are described. The mid-term outlook and long-term trends for the various energy sources are noted. A list of contracts awarded and a summary of information-gathering activities are included. GRA

N77-27560# Federal Power Commission, Washington, D. C. Bureau of Power.
FACTORS AFFECTING THE ELECTRIC POWER SUPPLY, 1980-85: EXECUTIVE SUMMARY AND RECOMMENDATIONS
1 Dec. 1976 55 p refs
(PB-264760/0) Avail: NTIS HC A04/MF A01 CSCL 10B

The overall nationwide supply of electric power and major potential problems which can adversely affect regional power supplies during the 1980-1985 period are discussed. GRA

N77-27561# Maine Univ., Orono. Dept. of Electrical Engineering.
TERNARY COMPOUND THIN FILM SOLAR CELLS - I Quarterly Report, 1 Sep. - 31 Dec. 1976
L. L. Kazmerski Jan. 1977 68 p refs Sponsored in part by ERDA
(Grant NSF AER-75-19576-A01)
(PB-265003/4; NSF/RA-760448; QR-1) Avail: NTIS HC A04/MF A01 CSCL 10B

The electrical properties - mobility, conductivity, carrier type and carrier concentration - are reported. A thin-film CdS/CuInTe2 heterojunction has been fabricated. Dark IV-characteristics are presented for in-situ provided devices. The photovoltaic effect for this heterostructure is discussed. Finally, the fabrication and characterization of n,p-CuInS2 thin film homojunction solar cells are presented. GRA

N77-27562# Economic Research Service, Washington, D. C.
ENERGY AND US AGRICULTURE. 1974 DATA BASE, VOLUME 1. PART A: US SERIES OF ENERGY TABLES. PART B: STATE SERIES OF ENERGY TABLES
R. T. VanArsdale and E. Rall Sep. 1976 266 p
(PB-264449/0; FEA/D-76/459) Avail: NTIS HC A12/MF A01 CSCL 02D

Energy consumption estimates are presented for both national and state levels by fuel type, fertilizer and pesticides, by commodity, by month, and by categories of functional use, including irrigation and crop drying. GRA

N77-27563# National Bureau of Standards, Washington, D. C. Metallurgy Div.
PREVENTION OF FAILURES IN COAL CONVERSION SYSTEMS: PRODEEDINGS OF THE 24TH MEETING OF THE MECHANICAL FAILURES PREVENTION GROUP
T. Robert Shives and William A. Willard Apr. 1977 237 p refs Conf. Proc. held at Columbus, Ohio, 21-23 Apr. 1976 Sponsored in part by Frankford Arsenal, ONR, FAA, ERDA, NADC, and Battelle Columbus Labs.
(PB-265552/0; NBS-SP-468; LC-77-608043) Avail: NTIS HC A11/MF A01 CSCL 07A

A series of overview lectures dealing with reliability problems in coal conversion systems, economics of failures in energy generating systems, corrosion, and gaps in engineering data are presented. In addition, failure analysis, materials problems, and related materials research are discussed. GRA

N77-27564# Systems Science and Software, La Jolla, Calif.
COMPUTER SIMULATION OF GEOTHERMAL RESERVOIRS
D. H. Brownell, Jr., S. K. Garg, and J. W. Pritchett 1975 11 p refs Presented at 45th Ann. Calif. Regional Meeting of the Soc. of Petrol. Eng. of AIME, Ventura, Calif., 2-4 Apr. 1975 Prepared in cooperation with Colorado. Univ., Boulder
(Grants NSF GI-43884; NSF GI-44212)
(PB-265104/0; NSF/RA/N-75-352; SPE-5351) Avail: NTIS HC A02/MF A01 CSCL 08I

General balance laws and constitutive relations are developed for convective hydrothermal geothermal reservoirs. A fully interacting rock fluid system is considered; typical rock-fluid interactions involve momentum and energy transfer, and the dependence of rock porosity (and permeability) upon the fluid and rock stresses. The mathematical model also includes multiphase (water/steam) effects. The geologic stress-strain behavior treatment permits the highly nonlinear and history-dependent constitutive behavior of the material to be properly taken into account. GRA

N77-27603 Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
MODELLING THE ATMOSPHERIC DISPERSAL OF RADIOACTIVE POLLUTANTS BEYOND THE FIRST FEW HOURS OF TRAVEL
H. M. ApSimon and A. J. H. Goddard *In* NATO Comm. on the Challenges of Mod. Soc. Proc. of the 7th Intern. Tech. Meeting

on Air Pollution Modeling and its Appl. 1976 p 915-930 refs Sponsored in part by EURATOM

Avail: NTIS HC A99/MF A01

The application of this air pollution model in simulating the travel and dispersal of radioactive material over Europe following routine release from nuclear power installations is illustrated, along with exposure and population doses resulting from inhalation. The model considers releases of a few hours duration from any chosen site, and uses pressure fields over Europe at six hour intervals during and after release, together with quasi-geostrophic forecasting techniques. These techniques were used to track the meandering paths taken by a series of discrete puffs of radioactive material until they left the map area. Along the path of each puff, local meteorological data including cloud cover and rainfall at the time of passage were used to assess the likely state of the boundary layer. Author

N77-27625# Environmental Protection Agency, Washington, D. C. Office of the Administrator.

REPORT OF THE HEARING PANEL: NATIONAL PUBLIC HEARING ON POWER PLANT COMPLIANCE WITH SULFUR OXIDE AIR POLLUTION REGULATIONS

Jan. 1974 108 p refs Conf. held at Washington, D. C., 18 Oct. - 2 Nov. 1973

(PB-264891/3) Avail: NTIS HC A06/MF A01 CSCL 07A

Contents: summary and recommendations; background; utility compliance efforts; status of flue gas desulfurization technology (lime/limestone FGD technology, Wellman-Lord sodium-based scrubbing, technology summary); vendor guarantees; flue gas desulfurization system malfunctions; waste disposal; costs of flue gas desulfurization systems; time requirements for installation of flue gas desulfurization systems; and capacity of vendors to install flue gas desulfurization systems. GRA

N77-27651# California Univ., Livermore. Lawrence Livermore Lab.

ENERGY AND TECHNOLOGY REVIEW

R. W. Selden Nov. 1976 17 p refs

(Contract W-7405-eng-48)

(UCRL-52000-76-11) Avail: NTIS HC A02/MF A01

The resolution of serious discrepancy between lunar magnetic field data and melting studies of lunar basalts is discussed. Estimates of the subsurface temperature, based on lunar electrical conductivity measurements and laboratory experiments, were hundreds of degrees below those given by models using known melting points of various minerals. A basic flaw in previous measurements was uncovered. New measurements under more realistic conditions brought the electrical conductivity temperature estimates into agreement with temperatures derived from melting experiments. A satellite ozone analysis center is also described. It is expected to produce daily high resolution global maps of ozone concentration. Correlated with ground observations, these maps should make it possible to establish the average ozone level, to check the effects of solar flares, volcanic eruptions, and atmospheric nuclear tests on that level, to detect long term trends in ozone concentration, and eventually to predict the effects of various forms of atmospheric pollution. Finally, a computer pattern recognition system for analyzing crime is discussed. D.M.L.

N77-27689 Indiana Univ., Bloomington.

PACE AND GRADE RELATED TO THE OXYGEN AND ENERGY REQUIREMENTS, AND THE MECHANICS OF TREADMILL RUNNING Ph.D. Thesis

Phillip Likins Henson 1976 139 p

Avail: Univ. Microfilms Order No. 77-1986

The relationships among variations in running speed and grade, and their effects upon various physiological variables in running at a steady state, are investigated. Also determined were changes in various biomechanical variables which occurred along with changes in speed and grade. Some of the conclusions drawn from the investigation were: energy is conserved by running downhill. However, the savings are less than the additional amount required to run the same incline at the same speed; and uphill running is accompanied by a slight forward body lean toward the incline. Dissert. Abstr.

N77-27761# Argonne National Lab., Ill.

OVERVIEW OF MINPACK

Michael Minkoff 1976 9 p refs Presented at Joint Conf. of the Am. Sect. of the Intern. Solar Energy Soc. and the Solar Energy Soc. of Can., Inc., Winnipeg, Canada, 15 Aug. 1976

(Contract W-31-109-eng-38)

(CONF-760842-19) Avail: NTIS HC A02/MF A01

The status and some possible future plans of the MINPACK project under development at the Applied Mathematics Division of Argonne National Laboratory are described. The need for developing a nonlinear optimization package arose in connection with revising the nonlinear optimization routines in the local computer library, and work in ERDA on the mathematical optimization of economic and energy models. The MINPACK project is a software project in areas related to mathematical optimization and has aspects dealing with the development and evaluation of algorithms, refinement of available implementations of existing algorithms, development of software implementing algorithms, and applications of these techniques to ERDA-related projects. A general overview of MINPACK and some of its current directions is given. ERA

N77-27901# Battelle Columbus Labs., Ohio.

EXPERIMENTAL SCREENING OF CARBON-BASE MATERIALS FOR IMPACT MEMBERS IN ISOTOPIC HEAT SOURCES

G. K. Bansel and W. H. Duckworth Nov. 1976 37 p refs

(Contract W-7405-eng-92)

(BMI-X-673) Avail: NTIS HC A03/MF A01

Several C/C composites and reentry-grade bulk graphites were evaluated experimentally to determine their applicability for impact member use in radioisotope heat sources. The composites included the following generic types: (1) 2-D cloth lay-ups; (2) 2-D and 3-D felts; (3) 3-D weaves; (4) 3-D pierced fabrics; (5) 7-D weave; and (6) coarse polar weave. A 2-D randomly wound, resin-impregnated C/C material (GIS) was also included. The various materials were evaluated as energy absorbing materials. None of the materials performed appreciably better than the GIS impact member material. Pyro Carb 903 and Carbitex 700 were somewhat superior in performance, while the bulk graphites and felt-base composites ranked least effective as energy absorbers. The results as a whole suggest that Pyro Carb 903 is the best prospect for a bifunctional heat shield and impact member. Its high density (1.80g/cm3) indicates potentially good ablation resistance to accompany its indicated good performance as an energy absorber. ERA

N77-27922# TRW Defense and Space Systems Group, Redondo Beach, Calif.

TRW 25 MW/SUB T/STAGED MHD COAL COMBUSTOR CONCEPTUAL DESIGN STUDY

4 Jun. 1976 363 p refs

(Contract W-31-109-eng-38)

(TID-27145) Avail: NTIS HC A16/MF A01

A 25 MW/sub T/ coal-fired combustor design and development program for MHD application is described. A program plan for the development and testing of the combustor and the scaleability of the design to larger sizes is also presented. ERA

N77-27923# Rocketdyne, Canoga Park, Calif.

MHD COMBUSTOR DESIGN STUDY Final Report

28 May 1976 440 p refs

(Contract W-31-109-eng-38)

(TID-27144; R-9967) Avail: NTIS HC A19/MF A01

The design concept and analysis study, including alternate concepts, are reported for a 25-MW/sub t/ coal-burning combustor that will supply hot gases to an MHD channel. Also included is a program plan for the design, fabrication, development, and testing of the 25-MW/sub t/ combustor and selected components; a test program to be conducted; a cost estimate

and schedule for the design, fabrication, and development effort; and an analysis and description of a 2,000-MW/sub t/ coal-burning combustor with the limitations to scaling up to such a combustor size. ERA

N77-27926# California Univ., Berkeley. Lawrence Berkeley Lab.
CONCEPTUAL DESIGN STUDY FOR A LASER FUSION HYBRID
J. A. Maniscalco Sep. 1976 20 p refs Presented at 2d Topical Meeting on the Technol. of Controlled Nucl. Fusion, Richland, Wash., 21 Sep. 1976
(Contract W-7405-ENG-48)
(UCRL-78682; Conf-760935-41) Avail: NTIS HC A02/MF A01

Feasibility evaluation was carried out by analyzing the integrated engineering performance of the complete conceptual design and by identifying the required laser/pellet performance. The performance of the laser fusion hybrid has also been compared to a typical fast breeder reactor. The results show that the laser fusion hybrid produces enough fissile material to fuel more than six light water reactors (LWR's) of equivalent thermal power while operating in a regime which requires an order of magnitude less laser and pellet performance than pure laser fusion. In comparison to a fast breeder reactor the hybrid produces 10 times more fissile fuel. An economic analysis of the design shows that the cost of electricity in a combined hybrid-LWR scenario is insensitive to the capital cost of the hybrid, increasing by only 20 to 40 percent when the capital cost of the hybrid ranges from 2 to 3 times more than an LWR. ERA

N77-27928# Argonne National Lab., Ill.
EXPERIMENTAL TWO-PHASE LIQUID-METAL MAGNETO-HYDRODYNAMIC GENERATOR PROGRAM Annual Report
M. Petrick, G. Fabris, R. Cole, R. Hantman, E. Pierson, and J. Cutting Nov. 1976 102 p refs
(Contract W-31-109-eng-38)
(ANL-ENG-76-04) Avail: NTIS HC A06/MF A01

The generator terminal and internal parameters were measured in a diverging channel liquid metal magnetohydrodynamic generator with gas injection along the insulating walls. Data are given for generator efficiency and load voltages, and the variations along the channel of liquid and gas velocities, pressure, local load factor, void fraction, and slip ratio. Comparisons are made with theoretical predictions. Tests made to evaluate the effectiveness of the gas injection indicated that the generator performance improved slightly as the amount of gas injected was decreased, and that the injected gas was not forming the desired pure-gas wall layer. The gas injection ports were removed, and substantial improvement was obtained in generator performance. Data comparable to that for gas injection is presented for this case. The future directions of the program, including the role of gas injection, and the modifications to the MaK-nitrogen facility are described. ERA

N77-27932# Los Alamos Scientific Lab., N. Mex.
PULSED ENERGY AND SWITCHING REQUIREMENTS FOR TOKAMAK OHMIC HEATING
H. F. Vogel, K. I. Thomassen, W. Bird (Texas Univ., Austin), and F. M. Heck (Westinghouse Electric Corp., Pittsburgh) 1976 8 p refs Presented at IEEE Intern. Pulsed Power Conf., Lubbock, Tex., 9-11 Nov. 1976
(Contract W-7405-eng-36)
(LA-UR-76-2473; Conf-761106-13) Avail: NTIS HC A02/MF A01

The electrical circuit requirements are presented which result from a study of the ohmic-heating system of a Tokamak Experimental Power Reactor (EPR). A computer model for plasma startup was developed as part of an electrical network analysis program. The results of a parametric study are presented in which the pulsed energy and voltsecond-requirements were optimized, electrical machinery was selected, and the switching requirements were defined. ERA

N77-27933# Los Alamos Scientific Lab., N. Mex.
SUPERCONDUCTING MAGNETIC ENERGY STORAGE
John D. Rogers 1976 26 p refs Presented at Pulsed Power Systems Workshop, White Oak, Md., 20 Sep. 1976
(Contract W-7405-eng-36)
(LA-UR-76-2047; Conf-760953-1) Avail: NTIS HC A03/MF A01

Fusion power production requires energy storage and transfer on short time scales to create confining magnetic fields and for heating plasmas. The theta pinch Scyllac Fusion Test Reactor (SFTR) requires 480 MJ of energy to drive the 5-T compression field with a 0.7-ms rise time. Tokamak Experimental Power Reactors (EPR) require 1 to 2 GJ of energy with a 1 to 2-s rise time for plasma ohmic heating. The design, development, and testing of four 300-kJ energy storage coils to satisfy the SFTR needs are described. Potential rotating machinery and homopolar energy systems for both the Reference Theta-Pinch Reactor (RTPR) and Tokamak ohmic-heating are presented. ERA

N77-27946# Argonne National Lab., Ill.
TOKAMAK EXPERIMENTAL POWER REACTOR
W. M. Stacey, Jr., M. A. Abdou, and P. J. Bertoncini 1976 21 p Presented at Ann. meeting of the Amer. Soc. of Mech. Eng., New York, 29 Nov. 1976
(Contract W-31-109-eng-38)
(CONF-761107-23) Avail: NTIS HC A02/MF A01

A Tokamak experimental power reactor designed to operate at net electrical power conditions with a plant capacity factor of 50 percent for 10 yrs operates in a pulsed mode at a frequency of approximately 1/min, with approximately 75 percent duty cycle, and is capable of producing approximately 72 MWe. Annual tritium consumption is 16 kg. The stainless steel vacuum chamber has beryllium coated coolant panels mounted on the interior and is surrounded by a stainless steel blanket and shield. The coolant is H20. Sixteen niobium-titanium superconducting toroidal field coils provide a field of 10 T at the coil and 4.47 at the plasma. Plasma current is driven by superconducting ohmic heating and equilibrium field coils. Plasma heating is accomplished by 12 neutral beam injectors which provide 60 MW. The energy transfer and storage system consists of a central superconducting storage ring, a homopolar energy storage unit, and a variety of inductor-convertors. ERA

N77-27951# Atomic Energy Organization of Iran, Teheran. Nuclear Research Center.
FUSION. THE FUTURE ENERGY SOURCE
1976 71 p refs In PERSIAN
(AEOI-10; NRC-76-7) Avail: NTIS MF A01; INIS Section, International Atomic Energy Agency, P. O. Box 590 A-1011, Vienna, Austria

It is proposed that Iran as a world's potential supplier of fossil fuel should participate in fusion research and gain experience in this new field. Fusion, as an ultimate source of energy in the future, and the problems concerned with the fusion reactors are reviewed. Furthermore, plasma heating and magnetic and inertial confinement in a fusion reactor are discussed. A brief description of Tokamak, theta pinch and magnetic mirror reactors is also included. ERA

N77-27983# Avco-Everett Research Lab., Everett, Mass.
HIGH POWER DENSITY MHD GENERATORS Final Technical Report
Robert Kessler Wright-Patterson AFB, Ohio AFAPL Mar. 1976 60 p refs
(Contract F33615-75-C-2047; AF Proj. 3145)
(AD-A038612; AFAPL-TR-76-71) Avail: NTIS HC A04/MF A01 CSCL 20I

Operating parameters were calculated for MHD generators operating at power densities in the channel of 500 MW/cu m and with power outputs of 30 - 35 MW (nominal). Liquid-fueled generators, using hydrocarbon fuels such as JP-4 or RP-1 and oxygen, and solid fuel generators were investigated. Designs of both liquid and solid fuel generators are described, and estimates of their weights and sizes are given. Operation of generators at power densities of 1000 MW/cu m was investigated.

Assessments of feasibility and risks involved in achieving high power density operation are made. A development plan for construction of flightweight high power density MHD generator power supplies is presented. Author (GRA)

N77-27996# Los Alamos Scientific Lab., N. Mex.
APPLICATIONS OF SUPERCONDUCTIVITY IN ELECTRIC POWER SYSTEMS
William E. Keller 1976 20 p refs Presented at the Frontiers of Power Technol. Conf., Stillwater, Okla., 27 Oct. 1976
(Contract W-7405-eng-36)
(LA-UR-76-1998; Conf-761030) Avail: NTIS HC A02/MF A01

Major applications of superconductivity to power systems are considered. The state of the art of materials and refrigeration developments that are necessary for these applications is reviewed. Specific applications including superconducting cables for power transmission and superconducting magnetics for MHD generators, for energy storage, and for magnetically confined fusion power generation are discussed in terms of their advantages and the progress being made toward introducing the various devices into real situations. It is concluded that the feasibility of superconducting devices is assured, and that, although their performance, reliability, and cost effectiveness for use in power generation, transmission, and storage remain to be proven, it is reasonable to expect that superconductivity can make it in the real world. ERA

N77-28038# California Univ., Livermore. Lawrence Livermore Lab.
HAWAII TECHNOLOGY UTILIZATION EXPERIMENT
David W. Dorn and Charles F. Miller 8 Dec. 1976 42 p
(Contract W-7405-eng-48)
(UCID-17343) Avail: NTIS HC A03/MF A01

A one year technology transfer project involving ERDA installations in Hawaii is described. Teams were sent on week long field trips every two months to test the effectiveness of different methods of transferring technology information from federal sources to civilian clients. Most inquiries involved biomass and use of agricultural wastes, solar energy, and transportation. Author (ERA)

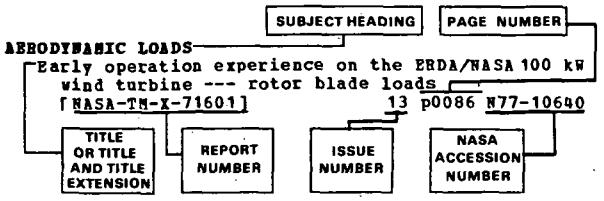
N77-28040# Demetroulis (Nicholas M.) and Associates, Alexandria, Va.
TECHNICAL REVIEW AND ANALYSIS OF THE TOTAL UTILITY DEMONSTRATION PLANT DESIGN AND OPERATIONAL CONCEPT Final Report
Nicholas M. Demetroulis Sep. 1976 58 p
(Contract DAAK02-75-C-0096)
(AD-A037016; USAFESA-RT-2031) Avail: NTIS HC A04/MF A01 CSCL 10/2

The total utilities concept involves the furnishing of all utilities to a facility from a single plant as a means of more efficiently using available energy from our fuel sources. These utilities would consist of all or part of the following: electricity, heating and air conditioning, water supply, sewage treatment, domestic hot water and trash disposal. The current practice is to obtain most of the above services from separate, non-affiliated corporate entities whose plants are widely separated and who have little incentive for cooperative action in waste energy utilization. Most electric generating plants, for example, are of large capacity and are remotely located so that even though vast waste energy quantities are available, the cost for collection, storage and distribution of such energy to consumers is prohibitive. Great amounts of energy are dissipated through cooling water, stack gases and power transmission which result in the loss of up to 60 percent of the energy initially available in the fuel. Another obvious resource waste is the practice of trash disposal through open burning, land fill or incineration without extraction and use of the considerable heat energy available. GRA

N77-28046# Institute for Defense Analyses, Arlington, Va. Program Analysis Div.
EVALUATION OF RAIL RAPID TRANSIT AND EXPRESS BUS SERVICE IN THE URBAN COMMUTER MARKET Final Report
J. Hayden Boyd, Norman Asher, and Elliot S. Wetzler Oct. 1973 267 p refs
(Contract DOT-OST-20019)
(PB-265236/0; DOT-TPI-10-77-11) Avail: NTIS HC A12/MF A01 CSCL 13B

Public transportation alternatives for serving the commuter market were investigated. The two main alternatives, rail rapid transit and integrated express bus service, are analyzed from the standpoint of full costs (both supplier and user time costs). User time costs of the two alternatives are roughly equal; however, the supplier costs of the integrated bus service are much lower than those of rail rapid transit. Quantitative data on fuel consumption and emissions are presented, and the effects of political, regulatory, and institutional constraints are discussed. GRA

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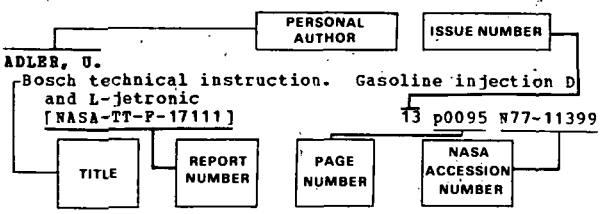
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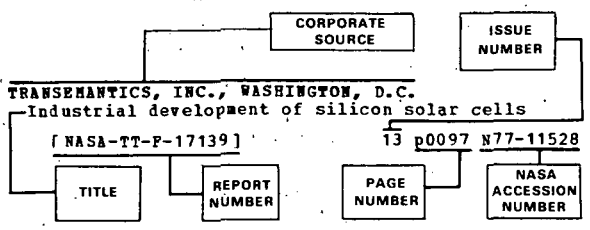
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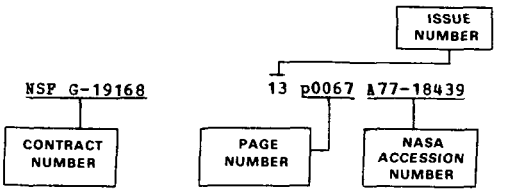
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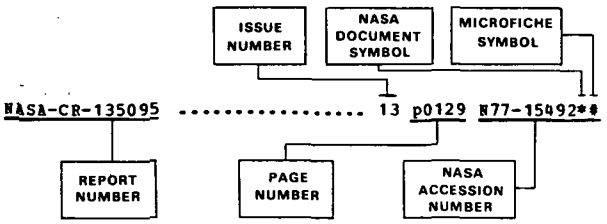
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COO-2602-2 14 p0210 N77-17216 #
COO-2603-1 14 p0212 N77-17582 #
COO-2607-2 15 p0357 N77-23626 #
COO-2615-76-T-1 14 p0223 N77-19613 #
COO-2683-76-1 14 p0232 N77-20603 #
COO-2683-76-3 14 p0229 N77-20568 #
COO-2683-76-5 14 p0230 N77-20569 #
COO-2683-76-7 14 p0217 N77-18579 #
COO-2683-76-8 14 p0230 N77-20570 #
COO-2683-76-9 14 p0230 N77-20571 #
COO-2683-76-10 14 p0230 N77-20572 #
COO-2683-76-11 15 p0383 N77-26674 #
COO-2687-4 14 p0215 N77-18564 #
COO-2687-5 15 p0361 N77-24571 #
COO-2688-76-6-VOL-1 14 p0224 N77-19632 #
COO-2688-76-6-VOL-2 14 p0224 N77-19633 #
COO-2688-76-6-VOL-3 14 p0224 N77-19634 #
COO-2693-76-1 14 p0249 N77-21683 #
COO-2693-76-2 14 p0222 N77-19610 #

COO-2698-1 14 p0224 N77-19635 #
COO-2699-2 13 p0087 N77-10651 #
COO-2699-3 13 p0098 N77-11538 #
COO-2703-2 13 p0129 N77-15498 #
COO-2704-3 14 p0250 N77-21697 #
COO-2721-76-1 15 p0383 N77-26670 #
COO-2727-4 15 p0357 N77-23631 #
COO-2732-1 14 p0250 N77-21692 #
COO-2749-15 15 p0390 N77-27410 #
COO-2791-2 15 p0391 N77-27509 #
COO-2865-1 15 p0372 N77-25635 #
COO-2868-1 15 p0383 N77-26676 #
COO-2888-1 15 p0365 N77-24609 #
COO-2895-T1 14 p0231 N77-20585 #
COO-2934-76-1 15 p0383 N77-26673 #
COO-2982-7 15 p0377 N77-26325 #

CRC-APRAC-CAPE-19-70-4 13 p0092 N77-10715 #

CRC-APRAC-CAPI-1-64-10 13 p0133 N77-15541 #

CRC-487 13 p0133 N77-15541 #

CRINC-2620-01 15 p0347 N77-22657 #

CRREL-SR-76-5 13 p0126 N77-14957 #

CRREL-TL-534 13 p0121 N77-14528 #

CRREL-76-33-PT-4 14 p0228 N77-20393 #

CTI-IV-75-01449 14 p0235 N77-21204 #

CTS-75-21 13 p0110 N77-12576 #

CW-WR-76-028.2 15 p0376 N77-26134*#

DARCOM-ITC-02-08-76-203 13 p0108 N77-12535 #

DES-76-9 15 p0362 N77-24572 #
DES-77-3 15 p0393 N77-27542 #

DGLR PAPER 76-182 13 p0059 A77-16533 #
DGLR PAPER 76-188 13 p0059 A77-16534 #
DGLR PAPER 76-189 13 p0059 A77-16551 #
DGLR PAPER 76-192 13 p0060 A77-16557 #
DGLR PAPER 76-198 13 p0060 A77-16575 #

DLR-FB-76-32 13 p0114 N77-13541 #
DLR-FB-76-32 14 p0251 N77-21701 #
DLR-FB-76-55 14 p0233 N77-20607 #
DLR-FB-76-55 15 p0365 N77-24615 #

DLR-IB-553-75/1 13 p0091 N77-10700 #

DM-16 13 p0114 N77-13539 #

DME-MD-53 13 p0124 N77-14609 #

DOC-76SDS4225 13 p0113 N77-13532*#

DOI-OMPRA-76/02 14 p0225 N77-19657 #
DOI-OMPRA-76/03 14 p0225 N77-19658 #

DOI/OMPRA/CL-76/01-PT-1 13 p0110 N77-12592 #

DOT-TPI-10-77-11 15 p0398 N77-28046 #

DOT-TSC-OST-76-27 15 p0354 N77-23507 #
DOT-TSC-OST-76-43 15 p0350 N77-22725 #

DOT-TST-76-57-1 13 p0133 N77-15930 #
DOT-TST-76-57-2 13 p0108 N77-12536 #
DOT-TST-76-69.1 13 p0117 N77-13922 #
DOT-TST-76-82 13 p0125 N77-14939 #

DREO-TN-76-15 15 p0356 N77-23613 #

DRI-9/76 15 p0352 N77-23010*#

DSE/2322-1 15 p0363 N77-24588 #

DTNSRDC-SPD-332-03 13 p0127 N77-15220 #

D6-75775 13 p0083 N77-10033*#
D6-75780 13 p0118 N77-14029*#
D6-75780 13 p0118 N77-14030*#
D210-10965-1 13 p0102 N77-12052 #
D277-10025-1 14 p0225 N77-19649 #

E-8076 13 p0086 N77-10640*#
E-8174 13 p0094 N77-11175*#
E-8715 13 p0127 N77-15208*#
E-8822 15 p0363 N77-24592*#
E-8828 14 p0213 N77-17852*#
E-8832 13 p0095 N77-11268*#
E-8879 13 p0083 N77-10116*#
E-8884 13 p0086 N77-10642*#
E-8885 13 p0105 N77-12517*#
E-8894 13 p0105 N77-12518*#
E-8896 13 p0097 N77-11529*#
E-8915 13 p0121 N77-14585*#
E-8929 14 p0207 N77-16445*#
E-8932 13 p0097 N77-11530*#
E-8956 13 p0106 N77-12519*#
E-8975 13 p0104 N77-12406*#
E-8982 13 p0128 N77-15487*#
E-8983 13 p0106 N77-12520*#
E-8984 13 p0114 N77-13534*#
E-8985 13 p0106 N77-12521*#
E-8991 13 p0114 N77-13535*#
E-8996 13 p0111 N77-13064*#
E-9001 13 p0114 N77-13536*#
E-9006 13 p0106 N77-12522*#
E-9007 13 p0106 N77-12523*#
E-9008 15 p0353 N77-23109*#
E-9036 15 p0363 N77-24587*#
E-9043 13 p0126 N77-15037*#
E-9066 14 p0229 N77-20563*#
E-9070 15 p0370 N77-25345*#
E-9075 14 p0214 N77-17947*#
E-9096 14 p0220 N77-19580*#
E-9105 15 p0353 N77-23114*#
E-9112 15 p0357 N77-23936*#
E-9131 15 p0354 N77-23487*#
E-9140 14 p0236 N77-21549*#
E-9142 15 p0343 N77-22608*#
E-9147 15 p0343 N77-22609*#
E-9148 15 p0376 N77-26222*#
E-9163 15 p0354 N77-23490*#
E-9194 15 p0378 N77-26613*#
E-9241 15 p0390 N77-27497*#

ECOM-76-1301-1 15 p0371 N77-25447 #
ECOM-4351 13 p0132 N77-15519 #
ECOM-4457 15 p0375 N77-25675 #

EEA/S-76/489 15 p0362 N77-24572 #

EHL-M-76M-2 13 p0110 N77-12571 #

EPA-R8-TS-5 14 p0208 N77-16457 #

EPA-330/2-76-025 13 p0116 N77-13566 #
EPA-330/3-75-001 13 p0104 N77-12486*#
EPA-340/2-76-001 15 p0368 N77-24672 #
EPA-450/2-76-004 13 p0083 N77-10220 #
EPA-450/2-76-016-A-VOL-1 14 p0213 N77-17647 #
EPA-450/3-76-012-B-VOL-2 13 p0092 N77-10709 #
EPA-450/3-76-036 15 p0371 N77-25551 #
EPA-460/3-76-014 13 p0102 N77-11603 #
EPA-600/2-75-048 13 p0084 N77-10221 #
EPA-600/2-76-057 13 p0115 N77-13551 #
EPA-600/2-76-061-A-VOL-1 14 p0234 N77-20639 #
EPA-600/2-76-090 14 p0233 N77-20610 #
EPA-600/2-76-093-A 15 p0352 N77-23021 #
EPA-600/2-76-093-B 13 p0101 N77-11581 #
EPA-600/2-76-098-A-VOL-1 13 p0091 N77-10686 #
EPA-600/2-76-098-B-VOL-2 13 p0115 N77-13549 #
EPA-600/2-76-101 13 p0125 N77-14638 #
EPA-600/2-76-127 13 p0110 N77-12581 #
EPA-600/2-76-130 13 p0092 N77-10722 #
EPA-600/2-76-136-A-VOL-1 13 p0110 N77-12597 #
EPA-600/2-76-148 14 p0219 N77-19279 #
EPA-600/2-76-149 13 p0125 N77-14645 #
EPA-600/2-76-152-A 13 p0116 N77-13569 #
EPA-600/2-76-152-B 13 p0116 N77-13570 #
EPA-600/2-76-152-C-VOL-3 13 p0125 N77-14643 #
EPA-600/2-76-153 14 p0209 N77-16470 #
EPA-600/2-76-177-A-VOL-1 13 p0103 N77-12231 #
EPA-600/2-76-182 13 p0133 N77-15540 #
EPA-600/2-76-208 13 p0133 N77-15919 #
EPA-600/2-76-209 13 p0133 N77-15550 #
EPA-600/2-76-259 15 p0350 N77-22705 #
EPA-600/2-76-284 15 p0368 N77-24671 #
EPA-600/2-77-008-A 15 p0359 N77-24316 #
EPA-600/3-76-034 15 p0125 N77-14631 #
EPA-600/4-76-056 15 p0376 N77-25685 #

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EPA-600/7-76-002 14 p0208 N77-16453 #
EPA-600/7-76-004-A 13 p0107 N77-12533 #
EPA-600/7-76-004-B 13 p0108 N77-12534 #
EPA-600/7-76-014 14 p0226 N77-19683 #
EPA-600/7-76-018 14 p0227 N77-19953 #
EPA-600/7-76-022 15 p0368 N77-24674 #
EPA-600/7-76-028 15 p0367 N77-24665 #
EPA-600/7-76-033 15 p0350 N77-22700 #
EPA-600/7-76-034-B-VOL-2 15 p0383 N77-26679 #
EPA-600/7-76-034-C-VOL-3 15 p0384 N77-26680 #
EPA-600/7-76-034-D-VOL-4 15 p0384 N77-26681 #
EPA-600/7-76-034-E-VOL-5 15 p0384 N77-26682 #
EPA-600/7-76-034-F-VOL-6 15 p0384 N77-26683 #
EPA-600/7-76-034-G-VOL-7 15 p0384 N77-26684 #
EPA-600/7-76-034-H-VOL-8 15 p0384 N77-26685 #
EPA-600/7-76-034-I-VOL-9 15 p0384 N77-26686 #
EPA-600/7-76-034-J-VOL-10 15 p0384 N77-26687 #
EPA-600/7-76-034-K-VOL-11 15 p0384 N77-26688 #
EPA-600/7-76-034-L-VOL-12 15 p0385 N77-26689 #
EPA-600/7-76-034-M-VOL-13 15 p0385 N77-26690 #
EPA-600/7-76-034-N-VOL-14 15 p0385 N77-26691 #
EPA-600/7-76-034-O-VOL-15 15 p0385 N77-26692 #
EPA-600/9-76-020 14 p0233 N77-20608 #
EPA-600/9-76-022 13 p0101 N77-11602 #
EPA-690/9-76-011 14 p0207 N77-16433 #
EPA-901/9-76-006 13 p0092 N77-10719 #

EPA/SW-123C 13 p0096 N77-11513 #

EPRI-AP-182 13 p0089 N77-10667 #
EPRI-AP-202 14 p0212 N77-17594 #
EPRI-AP-219 13 p0093 N77-10974 #
EPRI-AP-233 15 p0350 N77-22687 #

EPRI-EA-221-VOL-2 14 p0251 N77-21718 #
EPRI-EA-298 15 p0349 N77-22679 #

EPRI-EC-144 13 p0101 N77-11599 #

EPRI-EM-226 15 p0341 N77-22398 #
EPRI-EM-230 14 p0208 N77-16456 #
EPRI-EM-249 14 p0236 N77-21356 #
EPRI-EM-259 14 p0252 N77-21727 #
EPRI-EM-266 15 p0391 N77-27510 #
EPRI-EM-313-SR-VOL-1 14 p0230 N77-20577 #
EPRI-EM-335 15 p0391 N77-27508 #
EPRI-EM-336 15 p0392 N77-27516 #

EPRI-ER-188 13 p0109 N77-12551 #
EPRI-ER-198 14 p0208 N77-16459 #
EPRI-ER-203 14 p0234 N77-20880 #
EPRI-ER-248 14 p0234 N77-20879 #
EPRI-ER-283-SR-VOL-1 14 p0252 N77-21721 #
EPRI-ER-283-SR-VOL-2 14 p0252 N77-21722 #
EPRI-ER-299 15 p0349 N77-22680 #
EPRI-ER-301 14 p0251 N77-21712 #

EPRI-ES-115-VOL-1 13 p0088 N77-10662 #
EPRI-ES-115-VOL-2 13 p0089 N77-10663 #
EPRI-ES-187 14 p0208 N77-16449 #

EPRI-FP-164 13 p0100 N77-11563 #
EPRI-FP-165 13 p0109 N77-12568 #

EPRI-SR-39 13 p0092 N77-10707 #
EPRI-SR-45 13 p0100 N77-11561 #
EPRI-SR-46 13 p0132 N77-15528 #

EPRI-TPS-75-611 14 p0208 N77-16459 #

EPRI-223-1-FR 13 p0092 N77-10717 #
EPRI-1235-2A 13 p0110 N77-12598 #
EPRI-1235-3-FR 14 p0212 N77-17595 #

EQ-517613007 15 p0347 N77-22659 #

ERC-0123-3 15 p0380 N77-26640 #
ERC-7396-S 13 p0090 N77-10684 #
ERC-7396-S-3 14 p0213 N77-17603 #
ERC-7396-4 15 p0380 N77-26641 #

ERDA-SNS-3063-8 13 p0094 N77-11108 #

ERDA-TR-143 14 p0230 N77-20575 #
ERDA-TR-144 14 p0216 N77-18572 #
ERDA-TR-158 14 p0226 N77-19782 #
ERDA-TR-225 15 p0386 N77-26916 #
ERDA-TR-226 15 p0391 N77-27507 #

ERDA-23A 13 p0098 N77-11540 #
ERDA-76-1-VOL-2 14 p0222 N77-19600 #
ERDA-76-54 13 p0123 N77-14597 #
ERDA-76-63 14 p0222 N77-19611 #
ERDA-76-65 14 p0249 N77-21685 #
ERDA-76-69 13 p0130 N77-15506 #
ERDA-76-74 14 p0213 N77-17872 #
ERDA-76-77 14 p0213 N77-17883 #
ERDA-76-81 14 p0230 N77-20573 #
ERDA-76-109 14 p0222 N77-19602 #
ERDA-76-127 15 p0346 N77-22639 #
ERDA-76-131/1 15 p0355 N77-23607 #
ERDA-76-131/2 15 p0355 N77-23608 #
ERDA-76-138 15 p0344 N77-22621 #
ERDA-76-160 15 p0387 N77-26999 #

ERDA/JPL-1012-76/6 13 p0086 N77-10637*#
ERDA/JPL-954144-76/01 14 p0227 N77-19899*#
ERDA/JPL-954328-76/4 13 p0106 N77-12524*#
ERDA/JPL-954356-76/2 13 p0105 N77-12513*#
ERDA/JPL-954405-77/4 15 p0391 N77-27505*#
ERDA/JPL-954606-77/1 15 p0362 N77-24581*#
ERDA/NASA-0067/77/1 15 p0390 N77-27496*#
ERDA/NASA-1004/77/1 15 p0378 N77-26613*#
ERDA/NASA-1011/77/2 15 p0354 N77-23487*#
ERDA/NASA-1022/76/6 15 p0378 N77-26623*#
ERDA/NASA-1022/76/7 15 p0379 N77-26624*#
ERDA/NASA-1022/77/11 15 p0343 N77-22608*#
ERDA/NASA-1022/77/12 15 p0343 N77-22609*#
ERDA/NASA-1022/77/15 15 p0390 N77-27497*#
ERDA/NASA-19768 13 p0113 N77-13533*#
ERDA/NSF-00357/76/1 15 p0351 N77-22775 #
ERDA/NSF-00598/75/T1 14 p0218 N77-18667 #
ERDA/NSF-00603/75/T1 14 p0215 N77-18561 #
ERDA/NSF-00826/75/2 13 p0115 N77-13552 #
ERDA/NSF-07378/75/1 15 p0382 N77-26663 #
ERDA/SE/GI-43896/PR/75/10 13 p0090 N77-10676 #

ERG-76-04 13 p0122 N77-14592 #

ESA-CR(P)-911-VOL-1 15 p0354 N77-23175 #

ESA-SP-112-VOL-2 13 p0119 N77-14378 #

ESA-TT-338 14 p0251 N77-21701 #
ESA-TT-365 15 p0365 N77-24615 #

EXXON/GRU.2DYBA.75/715520 13 p0115 N77-13551 #
EXXON/GRU.16DJ.76 13 p0125 N77-14638 #

E77-10007 13 p0085 N77-10590*#
E77-10028 13 p0096 N77-11491*#
E77-10045 13 p0104 N77-12475*#
E77-10090 14 p0214 N77-18511*#
E77-10111 14 p0215 N77-18525*#

FCR-0237 15 p0380 N77-26637*#

FE-0390-1 13 p0097 N77-11535 #
FE-1235-1 13 p0130 N77-15500 #
FE-1236-4 13 p0130 N77-15507 #
FE-1514-176 13 p0088 N77-10653 #
FE-1521-13 13 p0130 N77-15501 #
FE-1552-18 14 p0222 N77-19602 #
FE-1765-7 13 p0127 N77-15401 #
FE-1765-8 13 p0120 N77-14488 #
FE-1770-4 13 p0093 N77-10812 #
FE-1772-11 13 p0088 N77-10658 #
FE-1775-3 13 p0130 N77-15502 #
FE-1814-2 13 p0130 N77-15503 #
FE-2201-4 13 p0130 N77-15506 #
FE-2307-2 14 p0224 N77-19637 #

FEA/B-76/028 13 p0111 N77-12930 #
FEA/B-76/218 13 p0099 N77-11553 #
FEA/B-76/219 13 p0093 N77-10941 #
FEA/B-76/221 13 p0086 N77-10633 #
FEA/B-76/281 13 p0084 N77-10224 #
FEA/B-76/307 13 p0108 N77-12540 #
FEA/B-76/308 15 p0360 N77-24321 #
FEA/B-76/317 13 p0096 N77-11515 #
FEA/B-76/335 13 p0124 N77-14608 #
FEA/B-76/351 14 p0208 N77-16450 #
FEA/B-76/352 15 p0341 N77-22292 #
FEA/B-76/384 14 p0218 N77-18596 #
FEA/B-76/403 14 p0208 N77-16455 #
FEA/B-76/463 14 p0235 N77-21257 #
FEA/B-76/702 13 p0107 N77-12527 #

FEA/D-CP-48 13 p0091 N77-10690 #
FEA/D-76/026 13 p0091 N77-10690 #
FEA/D-76/224 15 p0359 N77-24019 #
FEA/D-76/289 15 p0367 N77-24631 #
FEA/D-76/320 13 p0115 N77-13542 #
FEA/D-76/321 13 p0115 N77-13543 #
FEA/D-76/338 13 p0110 N77-12587 #
FEA/D-76/340 13 p0108 N77-12545 #
FEA/D-76/363 13 p0116 N77-13555 #
FEA/D-76/392 15 p0361 N77-24514 #
FEA/D-76/459 15 p0395 N77-27562 #
FEA/D-77/023 15 p0370 N77-25014 #
FEA/D-77/025 15 p0374 N77-25665 #
FEA/D-77/032 15 p0366 N77-24622 #
FEA/D-77/045 15 p0365 N77-24616 #
FEA/E-76/302 13 p0091 N77-10688 #
FEA/EI-1664 13 p0099 N77-11557 #
FEA/EI-1664-A 13 p0099 N77-11558 #
FEA/EI-1664-B 13 p0100 N77-11559 #
FEA/F-77/089 15 p0395 N77-27559 #
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FEA/G-75/710 13 p0132 N77-15523 #
FEA/G-76/154 15 p0348 N77-22673 #
FEA/G-76/193 13 p0109 N77-12549 #
FEA/G-76/323 15 p0389 N77-27316 #
FEA/G-76/328 14 p0212 N77-17598 #
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FEA/G-76/358 13 p0107 N77-12531 #
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FEA/G-76/369 13 p0115 N77-13553 #
FEA/G-76/394 13 p0132 N77-15527 #
FEA/G-76/428 15 p0374 N77-25667 #
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FEA/G-77/044 15 p0356 N77-23618 #
FEA/G-77/046 15 p0375 N77-25670 #
FEA/G-77/061 15 p0393 N77-27542 #
FEA/G-77/100 15 p0373 N77-25655 #
FEA/H-76/220 13 p0096 N77-11509 #
FEA/H-76/430 14 p0217 N77-18584 #
FEA/H-77/030 15 p0368 N77-24667 #
FEA/M-76/411-VOL-1 15 p0374 N77-25661 #
FEA/S-76/310 13 p0105 N77-12500 #
FEA/S-76/330 13 p0124 N77-14610 #
FEA/S-76/368 13 p0113 N77-13516 #
FEA/S-76/458 15 p0342 N77-22591 #
FEA/S-76/487-VOL-1 15 p0349 N77-22675 #
FEA/S-76/488-VOL-2 15 p0349 N77-22676 #
FEA/S-76/490 15 p0362 N77-24573 #
FEA/S-76/501 15 p0341 N77-22294 #
FEA/S-76/502 15 p0362 N77-24579 #
FEA/S-76/503 15 p0362 N77-24580 #
FEA/T-76/514 15 p0348 N77-22674 #
FEA/T-77/018 15 p0347 N77-22649 #
FEA/T-77/019 15 p0347 N77-22650 #
FEA/T-77/033 15 p0374 N77-25668 #

FES-76/1 13 p0096 N77-11509 #
FES-76/2-VOL-1 15 p0349 N77-22675 #
FES-76/2-VOL-2 15 p0349 N77-22676 #
FES-76/77-4 15 p0362 N77-24580 #
FES-76/77-6 15 p0362 N77-24579 #

FHWA-NHI-76-N001 13 p0100 N77-11562 #

FJSRL-TR-76-0008 14 p0226 N77-19659 #

FRA/ORD-76-297 15 p0366 N77-24629 #

FSEC-NSG-217-75/60 13 p0094 N77-11108 #

FTR-7 13 p0090 N77-10681 #

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GA-A-13661 13 p0093 N77-10891 #
GA-A-14074 15 p0351 N77-22968 #
GA-A-14097 15 p0393 N77-27539 #

GA/EE/76-1 15 p0353 N77-23143 #

GAI-1915 13 p0115 N77-13553 #

GEP/PH/76-11 15 p0361 N77-24483 #

GE76TMP-27 15 p0367 N77-24634 #

GPO-57-010 14 p0209 N77-17032 #
GPO-64-734 13 p0121 N77-14579
GPO-64-734-VOL-1 13 p0113 N77-13525
GPO-64-734-VOL-2 13 p0113 N77-13526
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TETRAT-A-642-75-169-PT-1-5 13 p0089 N77-10664 #
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